ELECTRICAL REVIEW

A WEEKLY JOURNAL OF

ELECTRIC LIGHT, TELEPHONE TELEGRAPH AND SCIENTIFIC PROGRESS.

(Formerly Review of Telegraph and Telephone.)

Vol. 4, No. 1. WEEKLY. NEW YORK, THURSDAY, MARCH 6, 1884. $3 per Annum. Single Copies, 10 Cents.

Copyright, 1883, by DELANO & COMPANY, 23 Park Row, New York.

Entered at Post Office, New York, as Mail Matter of the Second Class.

The Chesapeake and Potomac Telephone Company.

ITS PRESENT EXCELLENT CONDITION FOR FUTURE GROWTH—THE NEW PLANT PUT IN BY GENERAL MANAGER LYTLE.

The Chesapeake and Potomac Telephone Company organized July 3d, 1883. It was formed by merging the interests of the Telephone Exchange Co. of Maryland, and the National Capital Telephone Co. of the District of Columbia. The officers of the new company, as elected, were Morris F. Tyler, President; A. G. Davis, Vice-President; H. D. Cooke, Jr., Treasurer; H. B. Lytle, General Manager; Warren Choate, Secretary.

General Manager Lytle, upon whom mainly devolved the duty of re-organizing this company's affairs and reconstructing its plant, finding the systems both at Baltimore and Washington in a very inefficient condition for the development of the business, deemed it wise to take immediate steps to change the apparatus, and with this end in view ordered the Western Electric multiple Switch-boards for both cities. A large amount of work in the line of replacing wires with cables within a radius of a quarter of a mile of the central office in Baltimore had to be done before the Multiple Board could be used advantageously. The Multiple Boards which are herein illustrated are now in successful operation, both in Baltimore and Washington.

The new Baltimore system comprises eight Western Electric multiple switchboards, with a present capacity of 1,600 wires, an ultimate capacity of 4,900 wires, seven sections (100 wires each) wide, seven sections high, and are the largest as yet manufactured. The original Western Electric Company's arrangement of the cord circuits necessitated three keys for each pair of cords. Two were for calling on either one of the pair of cords; one for legging on the operator's instrument. This arrangement was improved upon by Lytle & McCoy, who arranged the cord circuits in such manner as to loop in the operator's telephone, where the old arrangement used twenty calling keys for ten pair of cords. With the new looping-in arrangement two keys for each group of any number of pairs of cords accomplished the same results. This we shall illustrate at another time.

The manner of suspending the operator's transmitter is believed to be original.

The method consists in suspending the transmitter by a loop of cord—the loop fastened to a single cord, which runs in two pulleys, one in front and one in back of cord rack. A weight is attached to the end of the cord. The transmitter can now be placed in any position from the bottom of the cord shelf to the key board. Suspended thus the transmitter catches up none of the vibrations or noise of the exchange. An operator wishing to stand adjusts the instrument for that position by an upward push.

Sixteen 100-wire cables enter the switchboard from what is called the switch-board test table, Fig. 4. This table comprises sixteen sections of hard rubber, each section eleven inches square, containing 100 binding posts set in ten inches square. One cable is run to each section, and the wires fastened permanently between the upper surface of the rubber and the bottom of the binding post; a screw passes through the rubber, and is screwed into the bottom of the binding post, drawing it down tight upon the wire. The 1,600 wires are thus connected permanently

A passage of three feet is left between this table and one similar, to which all the outside wires come in cables of 50 and 100 wires each.

In the place of binding posts, a device, such as shown in diagram No. 3, herewith is used; this forms a convenient and rapid method of testing either the outside or switchboard wires. By means of the screw the circuit may be broken and closed in an instant. It is never necessary to disconnect either a switchboard or outside wire. The connection between the tables are made by lengths of single office wire. All the charges from one outside wire to another, or from one switchboard wire to another, are accomplished by running wire from one testing table to the other, with a marked improvement in the service rendered.

The improved battery-stand, Fig. 5, is also believed to be original. For use in connection with the switchboards, there is required 24 transmitter batteries and 24 test batteries. Three shelves, arranged to carry 16 batteries each. The wires are imbedded in grooves running along the sides of the shelves, thickly coated with paint.

The lightning arrester for cable and testing, Figs. 6 and 7, consists of the combination of the ground plate and fine wire arrester, and of the spring jacks for testing by means of the wedge insulated on one side, cutting off the iron wire when testing through cable to exchange, and cutting off cable wire when testing iron wire.

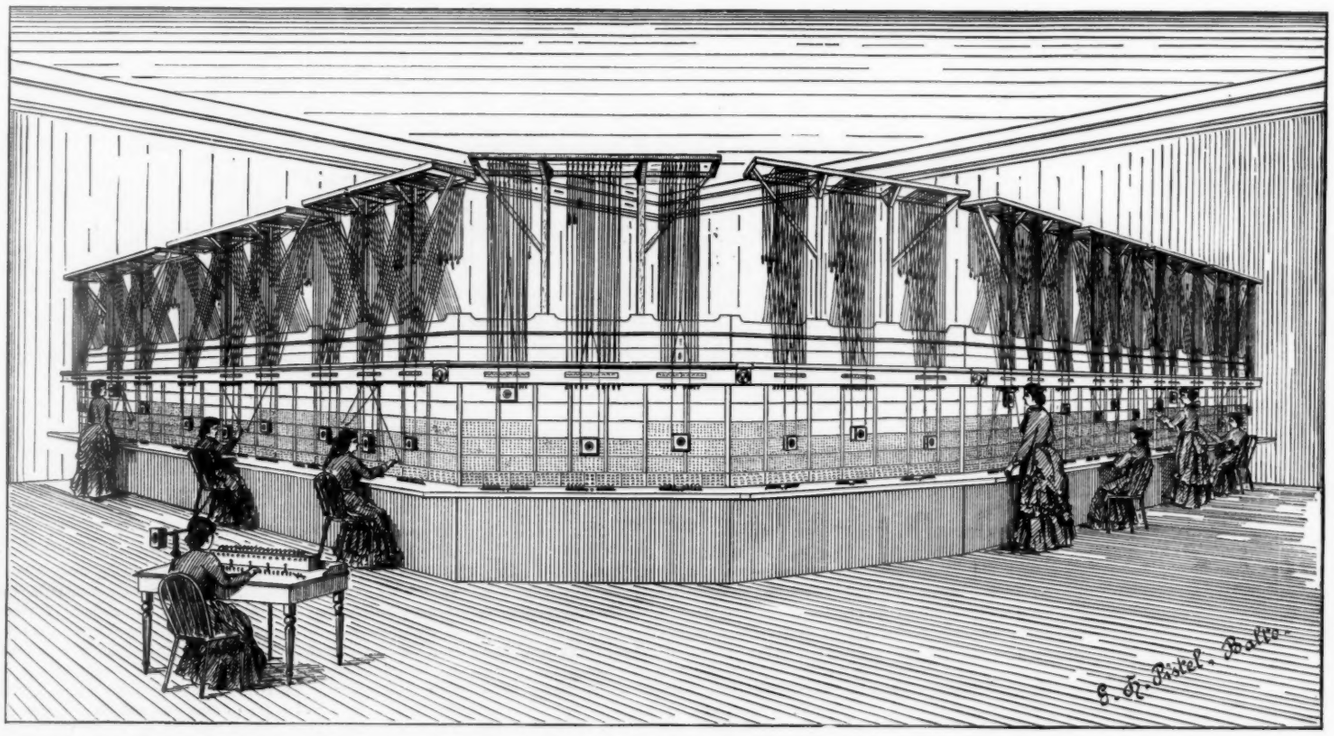


FIG 1.—THE WESTERN ELECTRIC MULTIPLE SWITCH BOARD IN THE NEW EXCHANGE, BALTIMORE, MD.

The point of excellence claimed for lightning arrester is the double safeguard consisting of the ground plate arrester and the fine wire. If an excessive current from any source fails to pass to ground *via* the ground plate, it encounters the fine wire, which passes and severs connection from cable, leaving the ground plate to protect the instruments at other end of line from danger. Also the rapid means of locating trouble either in the cable or on the wire, offered by the spring jack and single wedge, displacement of cable or line wire never being necessary.

Mr. F. M. Lytle, the superintendent of the Baltimore Division, is more than pleased with the new system, and is showing Baltimore patrons better service than they had ever expected was possible, and the system is now in shape to receive all the additional subscribers that can be obtained, and give them satisfactory service. The company,

previous to this, have not encouraged new subscribers here, for the reason that until the above changes were made in apparatus only very inferior service could be given; but now new patrons are being connected daily, and there is no doubt that Baltimore's growth for the next year will be very great.

It required a man of large conception and faith in the business to take hold of Baltimore as it was a year ago, for a large outlay of money was required before the company could expect any returns, but Gen. Manager Lytle was quite equal to the emergency, and from the first has worked solely with the aim to put the system in just the condition that it is to-day, and it is no flattery to say that he deserves the entire credit for the very excellent shape in which the company's plant and business is situated to-day. At Washington less outside work was required than at Baltimore, and the business there has shown handsome gains. Mr. W. D. McKinney, formerly superintendent of the Boston Exchange, has charge of this division, and the service is very satisfactory. A large number of instruments have been placed in the different departments, and there is a field in Washington for a continued growth. Trunk lines have been built during the past season between Baltimore and Washington and other principal points, and are working very satisfactorily.

All of the construction has been of the best, and so done that there is plenty of room for future growth, which is a fact too often overlooked.

A person looking over this company's territory would hardly think it possible such a change could be made in less than one year, as few traces can be seen of the old lines and apparatus. And in this connection we believe too much credit can hardly be given to general manager Lytle for the efficient manner in which he has pushed forward and demonstrated his policy of improving and extending the service in this territory, and demonstrating here, as he has twice before done in Providence and Boston, that the essential feature of the business is the employment of the most improved apperatus in the hands of operators who are zealous and active, and whose pride and hearts are in the business; with these elements of succcess the rapid growth of the business has been assured, and the benefits of his wise plans are being realized daily in a far greater measure and much earlier than was expected. His own improvements and those of F. M. Lytle and J. McCoy have of course contributed much towards this favorable showing as well as the faithful support of his assistants, Messrs. Miller, McCoy, Lytle and Kennedy, and the efficient and faithful lady operators in the Baltmore, Washington and Frederick Exchanges.

General Manager Lytle has, we understand, severed his connection with the Chesapeake and Potomac Company to accept a prominent and responsible position with a new company, which has been waiting for him for some two or three months, and whose prospectus will soon be issued. Business ability such as his is rarely found, and is needed in many companies now in the field, and it is safe to say that he will soon be heard from in a vigorous manner at an early day.

The Electric Light in St. Paul, Minn.

The *Dai'y Globe* of St. Paul of the 21st. inst. has the following interesting item concerning the Maxim Incandescent Light, just installed there:

"As becomes a metropolitan city like St. Paul, and our esteemed and public spirited citizen, Commodore W. F. Davidson, his new Grand Opera House was brilliantly illuminated last night, and at the matinee today, with 270 U. S. Electric Light Company's Maxim incandescent electric lights, their pure white and exceedingly steady rays producing a most charming and pleasing effect, greatly in contrast with the yellow, dull and flickering gas.

"These little lights burn in a small glass sphere, about two inches in diameter, from which the air has been exhausted, and are arranged upon the gas fixtures in a very artistic manner, adding very greatly to their beauty.

"Throughout the performances it was very plainly noticeable that the air was free from the noxious and stupefying gases given off by burning gas, and that the temperature was not perceptibly increased, which result arises from the fact that these lights burn in a vacuum and do not in the least vitiate the air, and emit little or no perceptible heat, while the gas in the same room will raise the temperature from fifteen to twenty degrees in less than an hour, rendering the house almost untenantable in warm weather, and its noxious vapor very soon tarnishes and injures the decorations. The lights are so arranged that the center, border, foot and house lights could be turned off or on, dim or bright, as desired, independent of each other, and all controlled on the stage.

"The Weston dynamos are in the engine room in the basement, driven by an Ide automatic cut-off engine of a new type, and perfect in construction, speed and setting.

"W. H. Tucker has been the electrical engineer in charge, and the engine work was under the supervision of J. H. Woolsey, A. W. Morrell and A. H. Gibbon. Every part of the work shows master skill, and but few little wires are visible. Miner's theater in New York, and the Buckingham, in Louisville, Ky., are lighted in the same manner, and give unqualified satisfaction, and ere long our churches, counting rooms and homes will be lighted in the same way. The public will universally rejoice that it is such a grand success, and special thanks are due Commodore W. F. Davidson for his public spirited interest in the comfort of his patrons."

All telephone people should carefully read the important news concerning their interests published from week to week in the REVIEW.

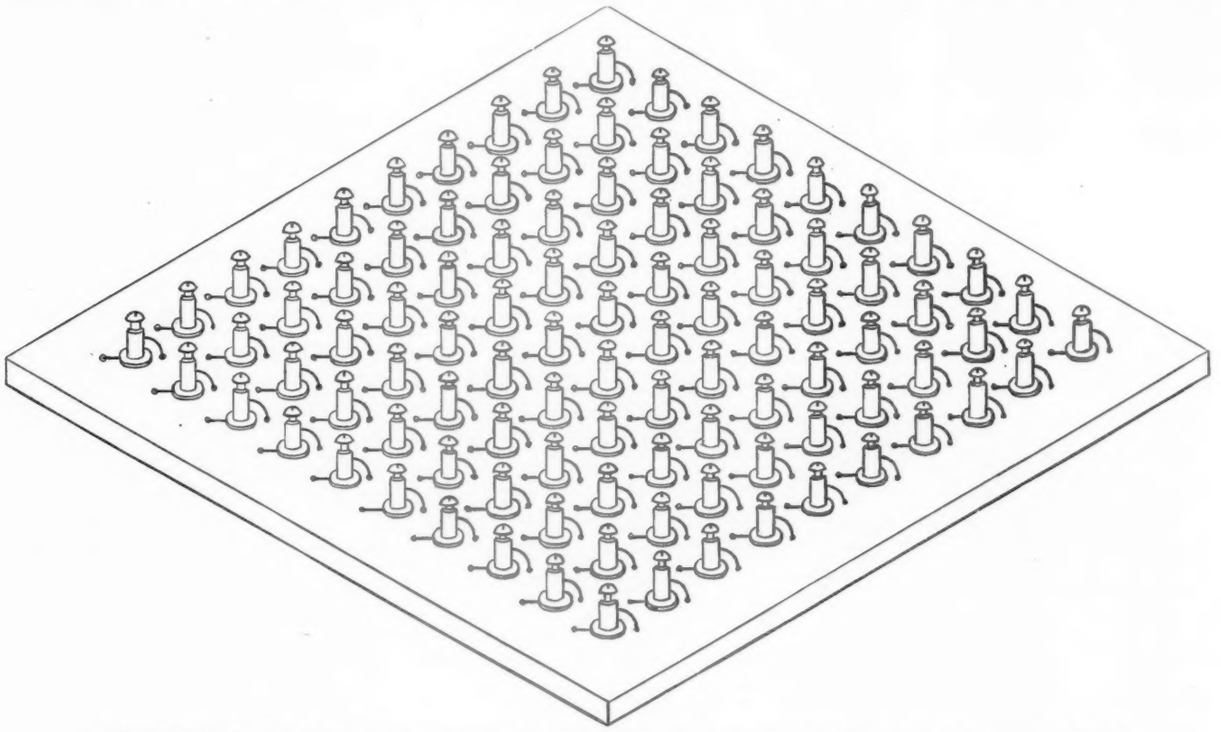


FIG. 2.—100 WIRE SECTION OF TESTING TABLE SHOWING PERMANENT TERMINALS AT BOTTOM OF SCREW CUP OF SWITCHBOARD CABLES.

ELECTRIC PROPULSION.

Its Application to Elevated Railroads.

ESTIMATE FOR EQUIPPING THE ELEVATED RAILROADS OF THIS CITY FOR ELECTRICAL PROPULSION.

In view of the rapid advance toward perfection of electric railway propulsion, it becomes of interest to consider the probable effect of its introduction upon existing systems and such as may be in contemplation. While there is not yet accessible a sufficiently long continued record of electric railway performance to establish its claim to commercial success, beyond question there is still ample ground in what has been done at Lichterfelde, Port Rush, and Saratoga for the belief that it may be predicted with tolerable certainty. Abstract reasoning upon such questions necessarily possesses a variable weight, while a conveniently cited instance is its own credential. Exactly such a one is not yet available, but a cognate method of discussion, which is entirely legitimate, is outlined in the caption of this essay. It is a bare comparison of facts and figures, which may be verified without much difficulty. The disproval of any of them—possibly of one—would break the chain of the argument; but if they are unimpeached, it is demonstrated.

The elevated railway system of New York city comprises—inclusive of sidings, &c.—thirty-two miles of track. Upon this roadbed are, or may be, running simultaneously 150 locomotives, each weighing, with its coal, water, and *personnel*, 44,800 pounds, and drawing, at a speed of 13.25 miles per hour, three cars, each weighing, with its seated load of forty-eight persons and the gateman, 34,230 pounds. Summing up, it amounts to a total weight of 22,123,500 pounds, moved 1,166 feet per minute. Taking the commonly accepted co-efficient for resistance to traction in rapport of weight moved, under average conditions of rolling gear and road-bed, to be .004 (*vide* Clark, Holley, Molesworth, Haswell *et al.*), the total work performed by the locomotives in any one minute is 3,127 horse power nearly.

It is unnecessary to consider grade or curvature in applying the co-efficient of tractive resistance, since, of the total number of trains running to and fro, as many will be assisted as retarded by the former; and there being but 12 curves which change direction as much as 90° on all the routes, only 24 of the 150 trains in simultaneous motion could, by any possibility, be passing them at the same instant, and this would not materially affect the total resistance of traction. Further, the influence of curves on the elevated railways is minimized by the admirable method of coupling trains, and it may be added that electric propulsion readily admits of fitting a motor to each car and manipulating them all from one, which would almost entirely neutralize curve resistance.

To make sure that the estimate shall include the most adverse conditions possible, the cars may be considered as crowded to their utmost capacity, or carrying say 100 persons each, and encountering strong side winds. In such a case the co-efficient of traction might rise to .006, and the total work done at any instant would be at the rate of 5,444 horse power nearly.

The expense of performing this work with steam locomotives may be thus stated: It requires 227 of them; each costs $3,500, and is served by a driver and stoker, whose combined daily pay is a trifle over $5. Each may also be called upon at any moment to exert some thirty-six horse power, and the coal required per horse power may be estimated as follows: Each engine burns forty pounds per mile run, in the ordinary routine service of drawing trains, and the average speed per hour, inclusive of stops, is 12.5 miles. This is a consumption per engine of 500 pounds per hour. The quantities hitherto dealt with

have been maxima, and it will be necessary to modify them to get a fair average consumption of fuel per horse power developed. The weight of locomotive and the number of cars per train remain unchanged, but the feet moved through per minute are reduced to 1,100, and, assuming a load of 25 persons per car as a reasonable mean between running crowded morning and evening, half full in the middle of the day, and nearly empty at night, the load moved may be taken at 136,690 pounds. Applying the general co-efficient of traction, .004, this becomes 547 pounds moved 1,100 feet per minute, or 18 horse power, at a cost of nearly 28 pounds of coal per horse power per hour. Of course, it is almost impossible that each engine should burn this quantity for each actual horse power of work it performs. The warming of trains is included in it, and the average is no doubt vastly increased by the number of reserve engines which must be kept standing with banked fires ready for immediate service. The cause is not any unusual inefficiency of particular locomotives—although, at best, they are four times more wasteful performers of work than large stationary engines of the best type—but it is one inseparable from the system of subdivision of locomotive power, and it is therefore correct to say that, in such a system, a horse power costs 28 pounds of coal.

The statement will then be, taking an hour as the unit of time:

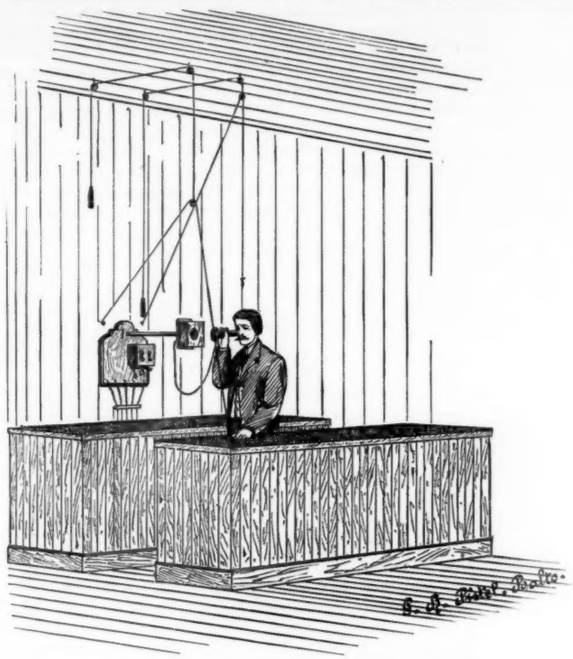


FIG. 4.—THE LYTLE AND MCCOY TESTING SYSTEM.

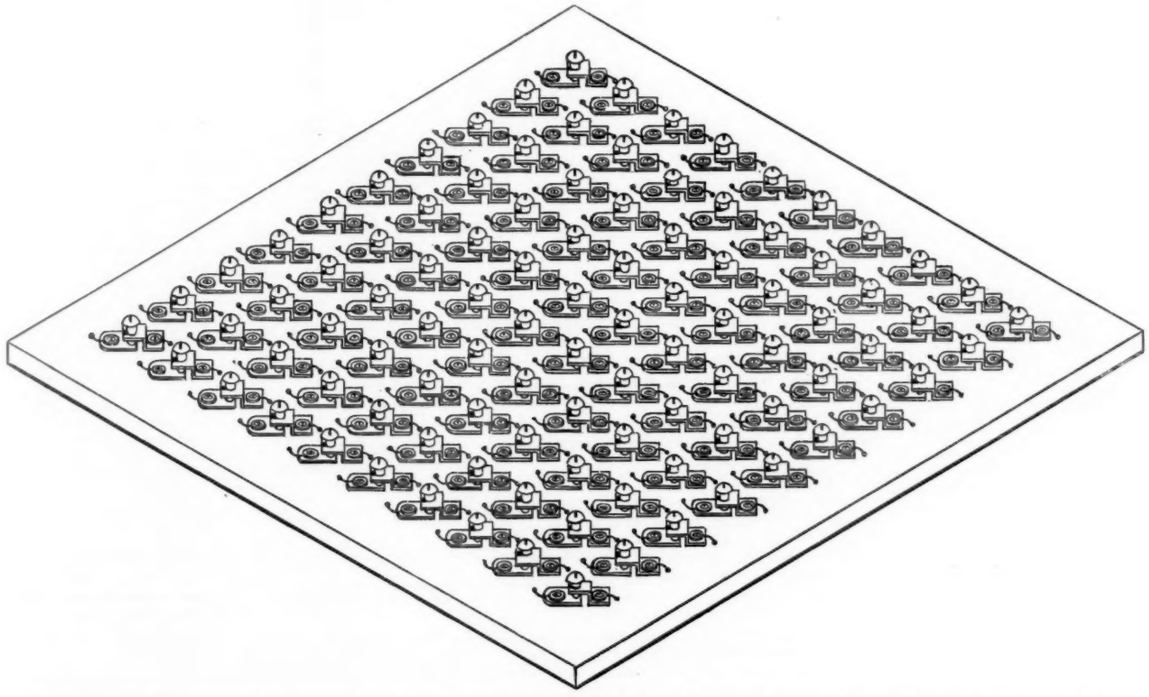


FIG. 3.—100 WIRE SECTION OF TESTING TABLE SHOWING PERMANANT TERMINALS ON RIGHT HAND OF SET SCREW OF OUTGOING CABLES.

Interest upon and depreciation of 227 locomotives @ $6,500, at the rate of 15 per cent. per annum...	$25 26
Wages of attendants for 227 locomotives	47 30
Total coal @ $3 per ton for 150 locomotives, developing 18 horse power each @ 28 pounds per horse power.	102 00
Total per hour.....	$174 56

To do the same work electrically would require the following named equipment:

It is quite possible to obtain dynamos which will return at any ordinary distance 75 per cent. of a horse power developed by steam engines at the generating station, and this can readily be had for 2 pounds of coal per hour from large improved constructions. But assuming 50 per cent., or thereabout, to be the ultimate and a duplicate installation to be superfluous—which latter assumption is in accord with expert opinion—the items will be:

Six stationary steam engines, 1,800 horse power each, with boilers, costing inclusive of erection....	$270,000
Eight generating dynamos, each 1,350 horse power capacity, inclusive of erection.....	273,375
One station-house at East 129th Street, for the Second and Third Avenue lines.....	$20,000
One ditto at Battery, for the Sixth and Ninth Avenue lines	30,000
227 electro-motors at $3,000.....	681,000
Thirty-two miles central rail, 35 pounds per yard, laid	40,000
Total.....	$1,314,375

This amount would in all likelihood be largely modified by the sale of the steam locomotives—which are of standard gauge—for use in short surface railways; but letting this probable rebate stand as an offset to unforeseen contingencies, the statement of current expense of electrical motive power concomitant plant will be, taking an hour as the unit of time:

Interest upon and depreciation of installation at 10 per cent. per annum.	$15 00
Total coal at 2 pounds per horse power and $3 per ton.....	28 93
Labor at power stations—	
Two chief and four assistant engineers at $22 per diem, forty stokers at $80 per diem	4 25
Wages of one attendant per motor, 227 at $3 per diem.....	28 38
Total per hour.....	$76 56

It should be explained *en passant* that the lower rate per cent. for depreciation of electrical machinery is based on superior durability due to its simplicity, few parts, and the absence of reciprocating movement. This amount is the total current cost of the maximum work done in any one hour upon all the lines. In comparison with the same quantity obtained through steam locomotives, the ratio is about as 1 to 2.28. In other words, electricity will perform for $1 the identical work for which steam charges $2.28.

Surprising as the result is, it does not embrace various advantages to which it is impossible to affix a quantitative value, such as reduced wear of road-bed by the great diminution of weight in the tractors. Some idea of this may be had by reflecting that the average adhesion to the rails of an electro-motor is, by reason of some molecular change in the contiguous surfaces of wheel and rail caused by the current circulating through them, about forty per cent. of its weight as compared with twenty per cent. in the steam locomotive. That is to say, an electro-motor of half the weight of a steam locomotive will haul the same load. The absence of smoke, exhaust steam, noise, and cinders dropping to the streets, is also of incalculable advantage in a city service.

Whether the conclusion arrived at be modified or not—it cannot be nullified—by further investigation, the indications are sufficiently clear to warrant stockholders of the elevated railways of New York in demanding of their several boards of directors an immediate and thorough examination of electric propulsion, and its earliest practicable adoption if its claims are substantiated.

T. WHITESIDE RAE, C.E.

Courting by Telephone.

AND ENDING THE COURTSHIP BY AN ELOPEMENT AND MARRIAGE.

SCRANTON.—This city is excited over the romantic runaway marriage of a young man named John R. Farr and a pretty Jewess named Justine Levy. The girl's family is greatly incensed over the union, and in the *Republican* of the 22d instant, right under the death notices, published the following announcement, surrounded by a deep, black border:

"Gone, and forgotten. We mourn the marriage of our sister, Justine Levy, to John R. Farr as dead, and disown her for life.

"LEVY FAMILY."

The publication of this notice has caused much comment. Farr, the hero of this escapade, is twenty-six years of age, a young man of excellent character, sober, studious, and industrious. He learned the printing trade in the office of the *Republican*, and saved enough money to secure a good schooling at Lafayette College, where he became quite popular as the champion runner. He is at present employed as assistant secretary of the Scranton School Board, and only a short time ago was elected a member of the board. His courtship of Miss Levy, who is a charming sixteen-year-old brunette—as intelligent as she is winsome—has been bitterly opposed by the girl's friends. The young couple finally had to make love through the telephone, and Miss Levy's relatives notified the exchange that unless this system of courting was stopped they would be compelled to cut out the telephone. Farr and his sweetheart succeeded in meeting several times, and were on Wednesday night surprised in an ice-cream saloon. They escaped through the back yard, scaled a high fence, and ran off to the residence of Rev. George E Guild, on

the outskirts of the city. There they were married at 2 o'clock yesterday morning, and the accommodating pastor gave them shelter for the night. The young couple are now living at Mr. Farr's home. The Farr and Levy families have had several stormy meetings, and a number of arrests are threatened.

American Electric and Illuminating Company in Montreal.

Last evening, says the Montreal *Herald*, Feb. 24th, at the invitation of Mr. M. Lee Ross. General Manager for Canada of the American Electric and Illuminating Company, of Boston, a number of newspaper men and others visited the works and factory for the purpose of witnessing certain improvements and inventions made by the company.

The party first visited the Central Station, No. 11 Inspector Street, where six electro-dynamo machines; two 25-light and four 12-light machines; the 125 horse-power engine was also inspected, after which the party left in sleighs for the factory in Down Street. Here the visitors were shown a variety of novel inventions and interesting experiments. One valuable invention, the automatic regulator, excited considerable attention. It consisted of a magnetic attachment of simple construction, secured to the machine for the purpose of adjusting the current to suit the number of lamps at any time in use. It served also to compensate for changes in the speed of the generator, and also to adjust the commutator of the machine. The next novelty inspected was a machine that indicated, by striking a bell, when any lamp in the circuit went out, and also showed on a dial the locality of the lamp.

A large number of lamps, single and double carbons and incandescent globe jets all operated at one time, on the same circuit, were next placed on exhibition. The manager also fully explained the process of manufacturing the dynamos, and the method of winding the armatures. An experiment never before performed outside of a laboratory was next gone through with; that of cooking by electricity. Mr. Thompson exhibited two miniature cooking apparatus, that were decidedly unique, producing the same results in an entirely different manner. By means of burning the arcs of a number of carbons sufficient heat was engendered to fry a couple of eggs, and, by the ingenious use of carbon resistance coils, some excellent tea was served up. The next novelty was the transmitting of enough power through five miles of wire to drive a circular saw. This was accomplished in the most successful manner, thick pieces of hard wood being cut through with ease. Then was shown a safety cut-off, by means of which the lamps of one-half of a circuit could be extinguished without affecting the other half; also a most important invention called an automatic cut-out. This last-named instrument was intended to be placed in every lighting station, and ensured safety to firemen should it become necessary for them to cut the wires. As soon as a wire was cut, this self-acting machine would cut off the current and extinguish all the lights in this section. In order to demonstrate this, Mr. Thompson cut one of the line wires, in the presence of the visitors, and then spliced it without turning off the current, the automatic cut-off having faithfully performed its office. This ended the exhibition, and the entire party then adjourned to the residence of Mr. Ross, in Upper University Street, where a collation had been prepared for them. After partaking of a sumptuous repast, the health of the host was drunk, and the party broke up.

The Baxter Electric Light Company.

This company is making rapid progress in disposing of their territory. We have to chronicle one excellent transaction of this character accomplished during the past week, upon which the company realized a handsome profit. The Keystone Electric Light Company, of Philadelphia, have bought of the Baxter Company the parent company's right to sell and equip electric lighting plants throughout the State of Pennsylvania. Mr. W. F. Griffiths is secretary of the Philadelphia company, and by energetic work they have already secured a good basis upon which to build a permanent business. With ample cash capital in hand, many orders for the Baxter attachment, and their stock quoted at 21 in the local market, we would be surprised if they did not make a great success. The Baxter Company have applications from almost every State in the Union, and are rapidly selling territorial rights to subsidiary companies.

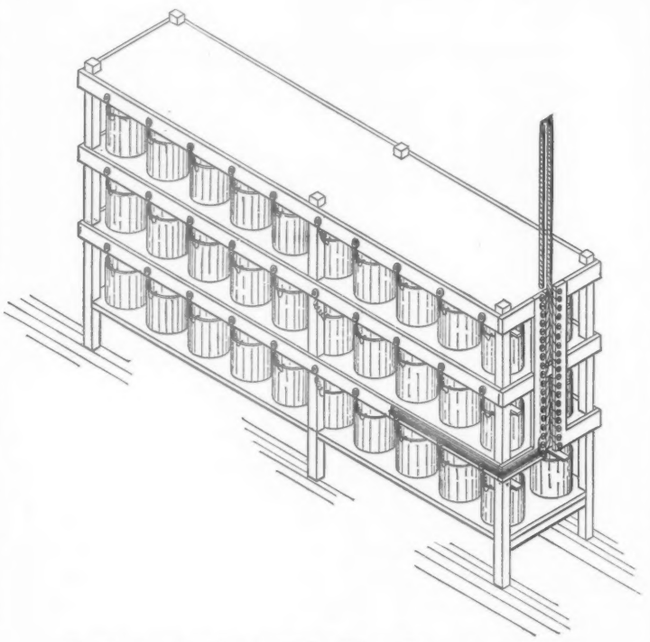


FIG. 5.—IMPROVED BATTERY RACK (WIRES CONCEALED IN FRAME).

Testing the Ide Engine at the U. S. Electric Light Works, South Bend, Ind.

The *Daily Tribune*, of South Bend, Ind, says the engine at the Electric Light Works at that place was fired up on the 21st inst, and all the lamps connected with the works turned on, which caused much wonderment among the patrons as to the cause of the sudden glare of the lamps at midday. The engine did its work satisfactorily, and was at the same time attached to the machinery of the five factories adjoining, which it drove with perfect ease. The engine is held in reserve in case of a failure of water power, so there will always be a reliable power at the Electric Light Station.

The test was made in the presence of several of our scientific men, machinists, practical engineers, and Mr. A. L. Ide, of Springfield, Ill., inventor and manufacturer of the engine. All were astonished at the power the engine displayed, as it being quite small in size did not seem to possess a capacity of over forty horse-power, but, according to the indicator attached, was really doing 95 to 100 horse power work, there being some 700 feet of shafting attached. The engine was started with the shafts of the Hodson, Stanfield & Company planing mill, the Boyd & Hillier planing mill, the Spethfeed mill, and the Bowsher speed indicator factory attached, in all requiring seventy-five horse power. This combination the engine handled with comparative ease, the power indicator showing a small draft on its resources, and the speed indicator showing a steady movement. The dynamos of the electric light works were then turned on one after the other until three were in motion, furnishing 50 lights, the addition to the work required of the little engine having no apparent effect on its speed, but the power indicator showing an increased output of energy.

Eighty-three per cent. of the population of the United States is composed of white natives, and the immigrants from Germany and Great Britain, leaving four per cent. from other countries, and thirteen per cent. for those of African descent.

Lady Siemens has kindly given 230 volumes from the library of her late husband, Sir William Siemens, to the Telegraph Engineers for their library—a gift which is sure to be highly appreciated.

The uses of electricity are many and various. We now hear that telephonic communication supersedes the old system of signaling and of hailing by speaking trumpet between vessels connected by a towing line. A wire is passed along the hawser, and communication is established with ease. We will probably hear next that vessels meeting at sea will be able to speak each other by one of them firing a wire to the other by means of the rocket apparatus. This would certainly be of great advantage in a stormy sea.

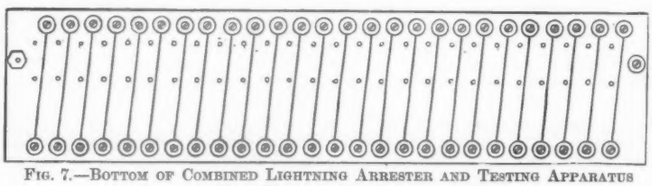


FIG. 7.—BOTTOM OF COMBINED LIGHTNING ARRESTER AND TESTING APPARATUS SHOWING FINE WIRE OR TIN FOIL CONNECTION.

The Excelsior Electric Light Company are doing a fair business in the East. One of their largest plants is located in Philadelphia, where the local management have secured a good patronage. The western manager for this company, Mr. T. W. Horne, is doing more in his territory to make this light a success than any person connected with the company. So far as we have been able to learn, Mr. Horne is an enterprising and successful business manager.

Electricity.

"I am often asked," said Mr. Edison, in regard to the probable progress of electricity in the future, what it is likely to do and what may be done with it. One answer really comprehends all. I believe that in time it will be the almost universal form in which energy or power will be used.

All who are interested in electrical science have a certain stock of questions which are asked over and over again whenever an opportunity presents itself. I have made a small collection of those oftenest compounded, and will here answer some of them.

One asks: "Will electricity be the universal beast of burden in the future? Will it carry us and our parcels, hew our wood, draw our water, cut our grain, cook our food, heat and light our houses, as well as furnish the motive power for our mills and factories?"

This beneficent result will, I think, be attained when electrical science has reached the point when electricity can be produced directly from the oxidation of combustibles instead of interpolating a boiler and steam-engine in the process.

Professor Tice defines electricity as the soul of the universe, the vital element of all moving matter; and I am asked if I am of the same opinion. I believe it is merely one form of motion, and the highest yet discovered.

Hon. S. S. Cox is quoted as having said that in the future, the near future, perhaps, no other agent of locomotion, heat, light or power will be resorted to. The opinion is well founded, and is shared by all who have given studious thought to the possibilities of electrical science.

As to the changes which will be effected by electricity within fifty years in the city of New York, I would say that I believe electricity will propel the cars of the street and elevated railroads, light the city within and without its buildings, furnish power for all purposes, work telephones and burglar alarms, deliver the opera, convey parcels, detect and signal fires, operate fire engines, and possibly displace animal locomotion for vehicles.

"The expression 'storing electricity' is in common use," says one. "Is such a thing possible?" In point of fact it is done every day, though, as yet, not economically enough to warrant its introduction as a commercial undertaking.

Another wants to know if the sun is not the indirect source of all the electricity in the world, or even in the universe? The sun, of course, is the source of all energy in our comparatively small planetary system. This energy takes various forms, one of which we call electricity.

The question I am often asked is, "Can electric appliances for light, heat and power ever be sufficiently cheapened to become available to the poor?" This stage of electrical development has already been reached in light and power. Electricity will prove itself a boon to the poor by breaking up aggregated industries. This, I believe, will be its greatest mission. It will subdivide power so that each operator can have his own, at a trifling cost, to do what he pleases with.

My belief is that in fifty years, or possibly sooner, we shall reach the electrical millennium—the day when electricity will do its work and be the general servitor of the people. The perfection of electrical science will, I think, have even a greater effect upon the industries, consequently upon the general condition of the people, than the introduction of steam.

As electricity is a mere infant, it is frequently asserted that its full growth will revolutionize almost all the practical interests of the world. Already, through the telegraph and telephone, it is revolutionizing all commercial methods, and will continue to do so to a much greater extent as it is utilized and developed in other directions.

"Will electricity ever be the motor which propels ships?" Yes, if it can be produced by the direct oxidation of combustible material.

I believe, also, that electricity will do greater wonders in transmitting and preserving sound than it has done. The electrical era is not all in the future. It has already begun. Probably fifty thousand persons throughout the world are engaged with the applications of electricity.

When it has reached its full development, electricity will not only lighten labor, it will enhance the safety of travelers and producers.

"Will it ever be as useful to the farmer as to the manufacturer?" some one asks. I think not—at least not soon—though it may be.

TELEGRAPHIC

The Chambers of Commerce, in London, adopted a resolution in favor of the formation of an International Telegraph Union, which should transmit messages at a low fixed rate. Postmaster-General Fawcett will be requested to submit suggestions looking to the accomplishment of this at the approaching telegraph conference.

The Cuba Submarine Telegraph Company report for the half year ended Dec 31, 1883, shows gross receipts, £18,990; gross expenditure, £9,796; leaving £9,194 to the credit of the revenue account. A dividend is recommended on ordinary shares, 7 per cent. per annum, free of income tax. The number of messages passing over the lines during the month of January was 3,291, estimated to produce £3,000, against 2,954 messages, producing £2,829, for the corresponding month of 1883. The traffic receipts for the month of October, estimated at £2,700, realized £2,744.

The certificate of incorporation of the Relief Telegraph Company was filed in the office of the County Clerk to-day. The lines of this company are to begin from its main office at or near the Stock Exchange, along, over and under the streets and avenues of this city, over and into buildings, and connecting public buildings, business houses and private residences with its branch offices. The capital stock of the company is $25,000, divided into 250 shares of $100 each, with the right to increase the same to $1,000,000, to be divided into 10,000 shares of $100 each. The corporators and the number of shares held by each are as follows: J. B. Yerkes, Plainfield, N. J., 200 shares; Robert Clark, Jr., Brooklyn, N. Y., 30 shares; Charles Earnest Wilson, New York City, 10 shares; and Thomas N. Morgan, New York City, 10 shares.

Articles of association of a corporation to be known as the Public Postal Telegraph were filed in the County Clerk's office, Tuesday. The corporation is to start with a capital stock of $100,000, divided into 1,000 shares of $100 each, held as follows:

William D. Snow, of Riverdale, N. J.; Benjamin F. Blair, Frank Rudd, and George M. Brooks, of New York, each twenty-five shares, and Ross C. Stone, of New York, 900 shares. One of the gentlemen interested in the company said last evening that it would attempt to utilize an entirely new system of telegraphy. Type-writing machines were to be used in the sending and receiving of messages, and any operator on these could learn to send telegrams in two months. The reporter's informant admitted that the new system was yet largely theoretical.

The Bankers and Merchants' Telegraph Co. have made the following changes: Jas. T. Maxwell, superintendent of the Third District, was appointed general superintendent, with headquarters at New York, his place being filled by M. S. Smith, who has heretofore been superintendent of the Metropolitan District and located in New York. Joseph W. Dyer was appointed manager in this city, and F. R. Webb, formerly chief operator, was made assistant manager. W. J. McLaughlin, formerly of the Bell Telephone service, succeeds as cashier D. R. Gibbs, who goes into the general superintendent's office at New York.

The Bankers' and Merchants' Telegraph Company.

The Senate Committee on Post Offices received to-day, from President A. W. Dimock, of the Bankers' and Merchants' Telegraph Company, a communication accompanied by a map, showing the extent of the company's lines. In this communication Mr. Dimock says:

"We fully appreciate how disastrous it would be for the people and business of this country to be left subject to the tyrannical control of the Western Union Telegraph Company. If there was no rescue from monopoly except by the strong hand of Government interference, then such interference would be justified in its origin and welcome in its results. But we respectfully claim that a telegraph system operated by the Government ought not to be adopted except as a last resort, when it clearly appears that the people, who are the sufferers from monopoly, are unable of themselves to obtain relief. Such relief may be obtained by competing companies. Of such competing companies the Bankers' and Merchants' Telegraph Company is the largest, and is from its very structure an anti-monopoly and popular corporation. It is not an adjunct to a railroad company, nor is the telegraphic apparatus of so novel and expensive a kind that it can hope to do business only between a few large cities. It was organized in 1881 because the then existing state of things was too oppressive to be borne, and it has since drawn to itself other organizations whose charters demanded freedom from monopoly and consequent independence of Western Union control in any form. There is no danger that this company will merge with the Western Union. Much of its most valuable property has been acquired on the express condition that, in case it shall cease to do business as an independent company, uncontrolled by those whose interests now lie with competing corporations, then the right to have or use such property shall cease, and, further, in case of any such merger with Western Union, the companies now associated as parts of the Bankers' and Merchants' Telegraph system would sever their present connection and be free to continue business as separate organizations. Nor can it be driven from the field by a war of rates. Its stock is wholly free from "water;" its property has been bought at fair prices and paid for in cash. By the excellence of its telegraphic service, it has more than held its own against all its competitors. As an illustration, I will merely cite the fact that it transmits more of the dispatches sent between the New York and Philadelphia Stock Exchanges (a service demanding the highest efficiency) than all other telegraph companies combined. It was one of the very few companies whose operators remained in service during the whole of the great telegraphers' strike."

Mr. Dimock further states that the company has in operation a pole mileage of nearly 5,000 miles, and a wire mileage of more than 34,000 miles, and has under contract, now building and to be completed within a very few months, a further wire mileage of over 30,000 miles.

The map which accompanies the communication is designed to show that the lines of the company will soon reach from the great lakes to the Gulf of Mexico, and from the Atlantic to the Missouri river. Mr. Dimock states that the company has a favorable contract with a cable company for a cable to Europe; that 400 offices are now in operation; that it has a contract with the United Press Association for the transmission of its news dispatches; that it has a controlling interest in the United States Telephone Company, and in the Commercial Telegram Company, under which stock and produce quotations are being distributed similarly with those furnished by the Gold and Stock Company, which is controlled by the Western Union.

In conclusion, President Dimock says: "We are ready to enter into a contract with the United States for the transmission of telegraphic dispatches over our lines upon very reasonable terms, and we believe that we can perform the service more efficiently and economically than it could be done by the Government."

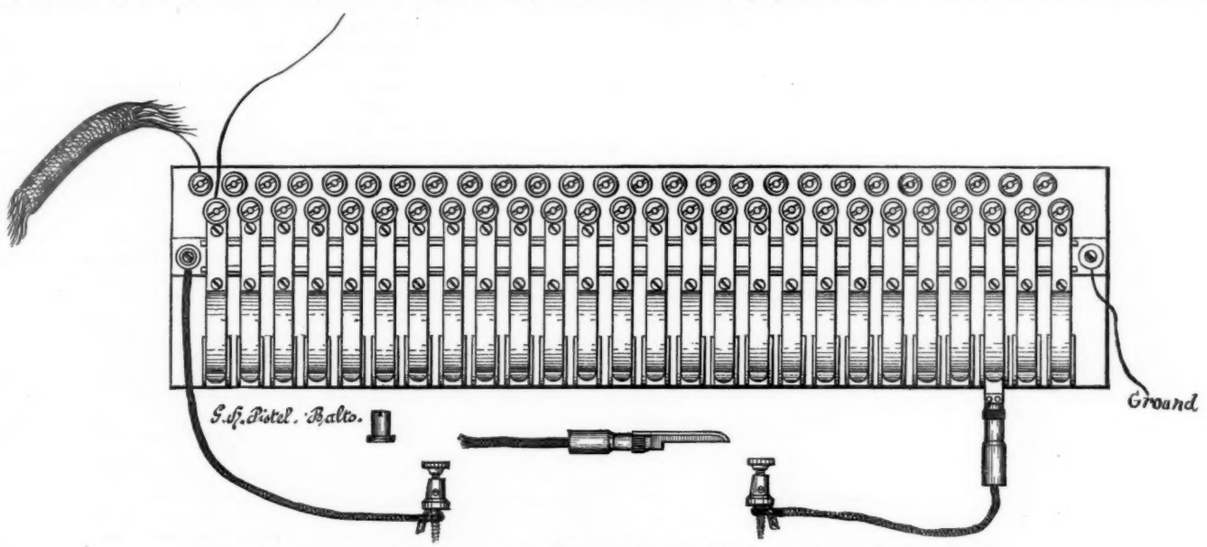


FIG. 6.—COMBINED LIGHTNING ARRESTER AND TESTING APPARATUS USED AT OUTSIDE ENDS OF CABLES.

We gather the following information interesting to telegraphers from Washburn & Moen's recent book on wire:

WHAT IS TELEGRAPH WIRE?

The following are among the official requisitions for telegraph wire:

Belgian.—"Iron wire of first quality, even running, without flaws or faults; well galvanized."

Prussian.—"To be subjected to 20 rectangular bends without breaking, and wound in a helical coil several times round a wire of its own size without split or break."

French.—"Annealed charcoal wire capable of bending at right angles to itself in a vise, first one way and then the other four times without breaking, and must stand wrapping round itself."

English Postal Telegraph.—"Highly annealed, and very soft and pliable; free from scales, splits, and inequalities. No deviation greater than .005 inch either way from prescribed diameter. Well galvanized."

Western Union Telegraph Company.—"Iron wire, to be soft and pliable, capable of bearing at least 2.5 its weight in pounds per mile. Well galvanized."

GRADES OF TELEGRAPH WIRE.

Iron wire manufactured exclusively for telegraphic service is known in the market in this country and abroad by terms common to the trade, as follows:

Extra Best Best (*E. B. B.*)—Made by improved continuous processes from the very best iron. It stands highest of any telegraph wire in conductivity, with a weight per mile ohm of from 4,600 to 5,100 lbs. Very uniform in quality, pure, tough, and pliable.

2 *Best Best* (*B. B.*)—Less uniform and tough than the above named, but stands a good mechanical test. "Weight per mile ohm," 5,500 to 5,800 lbs. Is largely used by some telegraph companies and in railway telegraph service.

3 "*Best*" (*B.*)—A term almost indiscriminately applied to the lower grades of wire designed for electric service. A harder and less pliable wire. "Weight per mile ohm," about 6,500.

4 "*Steel*" (or homogeneous metal).—More expressly designed for short line telephone service, where a measure of conductivity can be exchanged for tensile strength in a light wire. "Weight per mile ohm," 6,000 to 7,000 lbs.

ANNALS OF ELECTRIC TRANSMISSION.

1819	Oersted discovers Electro-Magnetism.
1882	Weber and Gauss invent electric telegraph.
1836	Cooke invents electric telegraph signaling.
1837	Morse invents combined circuits.
1838	Steinheil's discovery of earth-return circuit.
1839	First working Telegraph line (England).
1840	Morse's first patent (United States).
1842	Morse appropriation of $30,000 by Congress.
1842	Telegraph poles first used (England).
1844	Morse's first Telegraph line (United States).
1846	First Telegraph company, (England).
1851	First International Telegraph Conference.
1855	First International Telegraph Tariff.
1865	International Telegraph Treaty (European).
1872	Duplex system invented.
1874	Edison's quadruplex system.
1876	Telephone invented.
1881	National Telephone Exchange Association, Chicago.
1881	International Congress Electricians, Paris, Sept. 15.

Telephonic News

The Amsterdam exchange is preparing a petition addressed to the Netherlandish government, asking for better means of telegraphic communications with England.

In Japan the telegraphic system is extending to Niphon, Kiousiou, Likokf, and other islands, which form the Empire of the Extreme East. It measures now about 4,733 miles, or 12,470 miles of wire.

There are now 228 submarine telegraph cables, all told, some of them merely connecting islands with the main shore, or crossing narrow straits and arms of the sea, while others are thousands of miles in length.

As it is the case now between Magdeburg and Berlin, a telephonic service between the exchanges of Berlin, Leipsig, and Hamburg is on the point of being established. All the orders for exchange and all the financial transactions will then possibly be transmitted from one place to another by means of telephones.

The Late Storm in Boston.

It was the worst storm for their business since the start. The Telephone Company had over nine hundred wires broken, several fixtures down, but cables all intact. Not a trunk line working out of the central office, and the weather so severely cold that the men could do but comparatively little Saturday, and several of them had their ears and hands frozen.

Prof. Govi has contrived an experiment which he calls a demonstration of the principle of the telephone. He takes two tuning forks, which he puts in close proximity to two magnets, each of which is surrounded by a copper wire which serves to connect them together. On sounding one of the tuning forks with a bow, the vibrations are transmitted by the wire, and are reproduced in the other fork.

An instance of a witness testifying by telephone occurred recently during an inquest conducted by Coroner Creal at Saratoga Springs, relative to the death of Mrs. Jane Harrigan, who died suddenly at Schuylerville. Dr. Frank Gow, of Schuylerville, standing at his telephone, was administered the oath by the coroner in Saratoga, and then gave over the wire his evidence regarding his attendance upon the deceased before death.

On the 1st of December, 1883, the New England Telephone Co. had 16,771 subscribers. During that month it added 230, making its total number of subscribers 17,001. In January it added 458 more, bringing the aggregate up to 17,459, and this month it will do equally as well. The extra territorial business for December amounted to 25,600 messages, and for January to 36,000. The company at the present time is earning at the rate of six per cent. on its $6,000,000 of issued capital stock.

Messrs. A. G. Pollard and H. B. Shattuck who were appointed to audit the Erie Telephone Company's report for the quarter ending December 31, 1883, have just completed their examination of the accounts, and report that the company earned $68,000 net during the quarter, and that after paying the quarterly dividend (amounting to $48,000), $20,000 was carried to the surplus account, making the aggregate surplus $50,000. During the months of October, November and December there was an increase of 820 subscribers, and the total number on January 1st was 8,033. During the month of January about 300 more were added. The extra territorial business for the quarter amounted to 15,000 messages per month, or at the rate of $4,000, or $12,000 for the three months. The surplus in the treasury is now being used largely for construction purposes.

The net output of telephones for the month ended Feb. 20, the last of the fiscal year, was 2,799, a decrease of 3,007 from 1883, and 2,407 from 1882. The earnings of the company depend in small part only upon the output of telephones and will be large, even if there be no increase the coming year. The net earnings for the year 1883-84 will probably be over $1,400,000. The output of telephones for three years past has been :

	1881-2	1882-3	1883-4
March	4,593	5,192	4,739
April	5,331	6,600	7,342
May	5,757	7,469	6,758
June	5,735	6,339	7,088
July	4,238	3,787	5,846
August	5.021	4,078	3,569
September	3,024	4,270	4,366
October	4,140	4,136	3,706
November	4,943	5,083	3,811
December	5,080	4,532	4,191
January	3,687	4,744	3,164
February	5,206	5,806	2,799
Total	56,755	62,705	57,328

The stockholders of the Missouri, Kansas and United Telephone Companies held an adjourned annual meeting at the office of Secretary Crandall in Kansas City, on Monday last. Directors were elected as follows : W. B. Clarke, Junction City, Kas.; J. R. Mulvane, Topeka, Kas.; J. A. Corby, St. Joseph, Mo.; Jas. T. Lane, Davenport, Ia.; T. N. Vail, E. T. Gilliland, Geo. L. Phillips, Boston, Mass.; J. M, Coburn, C. D. Crandall, Kansas City, Mo.

Subsequently the new board of directors organized, and upon Mr. Clarke's declining a re-election to the presidency on account of his private banking interests, Mr. George L. Phillips was elected president of both companies, and Mr. C. D. Crandall, secretary and treasurer. Important business matters were disposed of and arrangements made for rapidly developing the territory of the companies, after which the meeting adjourned.

Mr. Phillips, the new president of the company, will remain in the city several days, looking after telephone interests. He has had much experience in telephone circles, and his acceptation of the presidency is especially gratifying to all interested in these companies.

Mr. Phillips is assistant general manager of the American Bell Telephone Company of Boston, which has bought a controlling interest in both companies. It is understood President Clarke's report is in the hands of the printer, and will be made public in a few days.

The Telephone Wires Cannot be Sunk.

Before the Senate Committee on Miscellaneous Corporations last week a hearing was had on Senator Daly's bill for underground wires.

Mr. Beardsley, representing the telephone companies in the various towns between New York and Albany, demonstrated how impossible it was to work telephone wires underground. He explained that the American Bell Telephone Company would gladly avail itself of any underground system that would insure good service, but that such had not up to the present time been discovered. How ridiculous it is for legislators to introduce bills regarding scientific work with which they are not acquainted, was seen in the discussion that followed this statement of the difficulties by Mr. Beardsley and Mr. Harrison. The press report says :

These statements were effectually refuted by Mr. D. S. Robeson, who appeared on behalf of the Standard Underground Cable Company, of Pittsburgh, and stated that a line of underground cable had been in successful operation in Pittsburgh for the past 20 months ; also that a line of the Waring Underground Cable, connecting the White House and the Capitol in Washington, and another line used by the Fire Alarm Telegraph of Washington have been in successful operation since November last. This statement was corroborated by documentary evidence from the Government and corporate Superintendents operating the above named lines. The hearing was adjourned to Tuesday next, when the electricians for and against the underground system will be further heard.

Those not familiar with the telephone business and the various obstacles, such as induction and retardation, would believe that the telephone people were simply trying to throw sand in the faces of the legislators engaged in investigating the scheme for underground wires. But this is not the case. Telephone lines, as is well known, will not work efficiently underground for a greater distance than half-a-mile, and even then the arrangements for the reception of the line must be of the most careful and expensive nature.

Now, as everybody knows, if the telephone, or at least telephone service, is not cheap and accurate it would not be popular. The ground is an enemy to telephonic service, and the telephone people are well aware, from the innumerable trials that they have made, that such an arrangement of wires could not be made underground without a great loss of efficiency and at an expense that would take the telephone out of the hands of the public and leave its benefits to be reaped only by the wealthy. This would, of course, be ruin to the companies, and who is prepared to say that the loss of the telephone, or which is the same thing, expensive telephone service would not prove a great hardship to the public ?

When a system of underground sub-ways shall have been constructed that will not interfere with the working of the telephone wires, they will be laid there, and not even the scheming of a band of monopolists who own a right to build sub-ways can force the telephone underground until that time comes.

Underground Wires.

ALBANY, N. Y.—At the hearing before the Senate Committee on Miscellaneous Corporations on the 26th, on Senator Daly's bill for placing wires under ground in New York and Brooklyn, Senator Daly strongly advocated the measure, replying to Burton N. Harrison's remarks at the last hearing. Mr. W. H. Eckert, General Manager of the Metropolitan Telegraph and Telephone Company, gave his views as to the impracticability of underground telephony in New York City. He was followed by Mr. W. D. Sargent, General Manager of the Brooklyn Telephone Company, who coincided with Mr. Eckert as to the necessity and advantages of having wires placed under ground, but denied the existence of any practical system for the operation of the same, stating the difficulties to be from induction and retardation. Mr. T. D. Lockwood, the electrician of the American Bell Telephone Company, of Boston, made a long statement, quoting largely from an English publication to prove the induction and retardation theories. By an interesting experiment Mr. Lockwood demonstrated to the committee the cause and nature of induction between electric wires. These gentleman protested that the question of expense did not inspire their opposition to placing the wires under ground.

Mr. Robeson, representing the Standard Underground Cable Company, read a letter from Capt. F. V. Greene, representing the Commissioners of the District of Columbia, in which he says that the underground cable in use for some months past by the telephone and fire alarm service of Washington, has shown the absolute success of underground wires for combined telegraph and telephone service, claiming that the entire freedom from the usual buzzing sounds on telephone lines shows its superiority over the aerial lines. Mr. Henry Van Hovenburg, in behalf of the underground system, was heard as to the working of subterranean lines, and in reply to the inquiries of the committee, stated that it was entirely practicable to operate the entire electrical system of New York and Brooklyn by means of underground wires. Mr. W. J. McElroy, followed in support of the underground system, giving the result of his experience in laying and operating subterranean wires. The committee adjourned to Tuesday next, when the telegraph companies will be heard.

Colonel Keller's Popularity.

THE MANAGERS OF THE ERIE TELEPHONE COMPANY OF THE SOUTH-WEST UNITE IN PRESENTING HIM WITH A SERVICE OF PLATE—ELEVEN PIECES—AS A TOKEN OF THEIR WARM PERSONAL FRIENDSHIP.

It is safe to say that no man ever identified with telephone interests in this country is more popular than Colonel J. N. Keller. Those who have known him longest and most intimately like him best, and those who have worked side by side with him have beheld him experience vexation and success without impatience on the one hand, nor exaltation on the other. And so it comes that the managers of the old South-western Telephone and Telegraph Company, now the Erie Telephone Company, which owes its prosperity to his admirable direction while general superintendent, determined to present him with a token of their esteem and friendship.

This token, taking the form of a silver tea service, purchased at Holmes, Booth & Hayden's, was presented to Colonel Keller on Friday last, in the office of the ELECTRICAL REVIEW, by Major Lorin N. Downs, General Manager of the Erie Telephone Company of the Southwest.

The names of these gentlemen are: Messrs. Dunbar, Vance, Ladd, Millburn, Jones, Wilson, Foster, Baker, Davidson, Clower, Adams and McMurray.

PRESENTATION REMARKS.

Your friends, the managers of the late South-western Telephone and Telegraph Company, have asked me to present to you, on their joint behalf, this token of their mutual regard for you personally. I must confess that I feel no little pride in thus being chosen on this occasion as their spokesman, because it gives me an opportunity, which I have long looked forward to, of expressing, not only my personal esteem for you, but also of acquainting you with the fact that your former associates of the South-western Telephone and Telegraph Company still remember those pleasant relations which for so long they had with you, and they have never ceased to regret that they should have been severed. The South-western Telephone and Telegraph Company has, as you kn w, been merged into the Erie Telephone Company, but its workings, which, for efficiency, are known far and wide, still bear the impress of your hand—still indicate an organization conceived by a master mind.

But it is not the skill you showed in surmounting difficulties, or the originality of which all your work bears testimony, that has bespoken for you our lasting friendship, or that has prompted us to hand you this insignificant testimonial in proof thereof. It is for the generous, kindly nature that was exhibited at all times; for the patience which you exercised under the most trying circumstances; for that love of justice which refused to decide, or even form an opinion, until both sides had been heard and the testimony all in.

These—these—are the qualities which have attached us to you, and which not even the interminable distances that separate us will serve to eradicate or to lessen.

Not one among all your former associates but begged to be permitted to take a part in sending you a token of friendship—not one whose remembrance of your kindly nature and generous instincts was willing to be left out.

Accept, then, Colonel Keller, this token of their esteem and friendship.

Set it down where often your eyes may rest upon it; and whenever you see it, may it bring back to your memory the lasting friendship of which it is the simple token, and a warm reminder of your South-western friends of lang syne.

COLONEL KELLER REPLIES.

GENTLEMEN—This is one of the pleasantest surprises of my life, and I know not how best to convey to you what pleasure it gives me to receive at your hands this beautiful testimonial of your regard.

Were it made of solid gold or precious stones, it would not be more prized by me. I shall never look at it without a feeling of pride—pride because I succeeded in retaining the friendship of old and tried associates, of whom, though working for years by their side under difficulties which, at times, seemed unsurmountable, I never found wanting, never found dilatory, when promptness was demanded, and never found faint-hearted when difficulty was to be encountered.

I am proud of the South-western Telephone and Telegraph Company and its employes. Through their untiring energy and faithfulness, the scheme proved a great success, and I can truthfully say that it is one of the best built and best-managed companies in the United States, and I feel confident that, so long as the employes remain that were there when I left, it will continue to grow and yield satisfactory incomes to its owners. When that enterprise was started, none of us knew anything about the telephone business. I can therefore take but little credit upon myself for bringing it to its present standard of perfection, but I do take the credit of gathering around me so superior a class of men.

I look back upon my career in Texas and Arkansas with pride and pleasure, feeling confident that I have many warm friends there who will always wish me, as I do them, prosperity and happiness.

Will you please convey to each one of the donors of this beautiful token my heartfelt thanks. Tell him that I shall ever treasure with gratitude the knowledge of his esteem and friendship.

Kansas City and North-western News.

KANSAS CITY, MO., Feb. 27, 1884.

The adjourned annual meeting of the stockholders of the Missouri and Kansas and United Telephone companies was held in the office of Secretary Crandall, this city, Wednesday last, and some important amendments to the by-laws adopted. These amendments increase the duties and authority of the president of the company.

The Board of Directors elected is the same as that of last year, with one exception, and consists of the following gentlemen: Geo. L. Phillips, E. T. Gilliland and Theo. N. Vail, of Boston; Joseph A. Corby, of St. Joseph, Mo.; J. R. Mulvane, of Topeka, Kansas; W. B. Clarke, of Junction City, Kansas; J. T. Lane, of Davenport, Iowa; J. M. Coburn and C. D. Crandall, Kansas City.

The retiring president of the two companies, Mr. W. B. Clarke, made the following reports of what had been done under his *regime:*

MISSOURI AND KANSAS TELEPHONE COMPANY.

On January 1st, 1883, the Missouri and Kansas Telephone Company owned and was operating eleven exchanges in the following cities, viz.: Kansas City, Jefferson City, Hannibal, St. Joseph, Sedalia, Mexico, Moberly and Independence, in Missouri; and Atchison, Leavenworth and Topeka, in Kansas, containing one thousand three hundred and forty (1,340) subscribers. On January 1st, 1884, they had added six more in Missouri, as follows: Boonville, Carrollton, Fulton, Louisiana, Marshall and Maryville. These new subscribers, with those added to their old exchanges, makes the total number now connected two thousand and eighteen (2,018). The exchanges at Kansas City, Hannibal, Sedalia and St. Joseph were rebuilt, enlarged and improved the past year at an expense of about forty-five thousand dollars ($45,000). There is still much work to be done on the Kansas City Exchange. At this point they have been unable to keep up with the demand for telephones, and many applicants have not subscribed that would do so were they able to obtain the telephones promptly. Certain lines of poles now building and contemplated will remove these objections, and enable them to keep up with the demand, and add to this exchange alone about five hundred new subscribers the coming year. During the past year this company has connected Topeka with Kansas City, and Leavenworth with Atchison, so we now have lines from Kansas City to St. Joseph, Atchison, Leavenworth, Lawrence and Topeka. These lines are one hundred and fifty-three miles in length, and have cost us twenty thousand three hundred ($20,300) dollars. The mileage of wire on poles owned by this company is nearly one thousand miles in length.

UNITED TELEPHONE COMPANY

was incorporated under the laws of Missouri on the 4th of April, 1883. At that time they acquired by purchase the property of the Merchants' Telephone and Telegraph Company of Missouri and Kansas, and the Joplin Telephone Company of Missouri. These two companies turned over to them fourteen exchanges, located in the following cities, viz.: Fort Scott, Emporia, Olathe, Lawrence, Parsons and Oswego, Winfield, Wellington, Salina, Ottawa, Wichita and Galena, of Kansas; also, Webb City and Carterville, Joplin and Carthage, of Missouri, with five hundred subscribers. Since that time they have built the following eleven exchanges: In Kansas, Junction City, Caldwell, Clay Center, Abilene, Arkansas City, Newton, Osage City and Burlinghame; in Missouri, Rich Hill, Butler and Nevada—adding to our former number five hundred and seventy-three subscribers. They also purchased from the Missouri and Kansas Telephone Co. the Springfield (Mo.) Exchange, having one hundred and twenty-five subscribers. They, therefore, have eleven hundred and ninety-eight subscribers at this time. They also have some hundred miles of connecting lines between Caldwell and Wellington, *via* Hunnewell and Ottawa and Burlingame, *via* Osage City, besides several short lines running out from Detroit, Enterprise and Fort Riley. These connecting lines are valuable links to their exchanges, and as toll lines are earning enough to justify and encourage further building in this direction. They have applications for exchanges at several points in Kansas and Missouri, which can be built the coming year, and largely increase our earnings account.

The reports of the treasurer were also submitted, showing that the Missouri and Kansas had paid $15,000 in dividends, and expended $40,000 in reconstructing the old plants having the gear, and passed to surplus account $16,545.80. The United had passed to surplus $7,000 of its earnings.

Mr. Geo. L. Phillips, of Boston, one of the most energetic and successful telephone men of the country, was selected by the Board of Directors as their president, and Mr. C. D. Crandall, as faithful and competent an official as any company ever had, was re-elected secretary of both companies.

All the other officials of the companies are to be appointed by Mr. Phillips, who, after planning extensive developments, to be put through in this city and elsewhere in the next thirty days, and after three days spent in familiarizing himself with the detailed affairs of the companies, left for the East to return in one month, and devote the greater part of his time to his large interests here.

Armstrong and Armourdale, Kansas, were connected by telephone with the Kansas City Exchange, last week. These towns are about four miles west of the city, and are both growing suburbs.

The Union Pacific Railway, Kansas division, has rebuilt its telegraph line from here west to Wamego, something over 100 miles. It is the intention of the company, I am informed, to reconstruct the line of the entire Kansas division. The poles are used for mile-posts, and the one-half miles are also marked, thirty-two poles being planted to the mile. These facts, coupled with that of thirty-foot rails being used, enables a conductor, in case of accident, to be able to tell his exact location to within a few inches. But this road has scarcely any accidents to chronicle, and its trains are always on time, thanks to the excellent management of General Superintendent A. T. Smith, and his superintendunt of telegraph, J. J. Burns. Mr. Smith probably has more telephones in his residence than any other person in the city, private lines extending from there to the various offices, shops, etc., in the city and suburbs.

It is currently talked of out here that the Pacific Mutual Telegraph Company, with lines extending to St. Louis and St. Joseph, has sold out to the Bankers and Merchants' Company, with Mr. Geo. M. Meyers, of the Pacific Mutual, to be superintendent of the Western division of the new company, his territory to include St. Louis.

A love affair, conducted through the telephone at Atchison, Kansas, has caused the husband of the fair one to apply for a divorce. If the Central Office operator is called into court to testify, richness will be expected, provided said operator can be made to divulge.

BI-POLAR.

Our correspondent writes as follows from Dunedin, New Zealand: We were on Monday last favored, by the courtesy of the chief telegraphist, with a view of the telephone room by means of which the connections are made between the various subscribers who desire to converse with each other and transact business. It is a sight worth seeing, and though at first somewhat bewildering, becomes more simple after a little study. Before an upright board about 8ft. long and 6ft. high, stood two operators, whose duty it is to perform the various functions by means of which free and rapid communications are rendered possible. The board is divided into five compartments, each with 50 numbers, or 250 in all, representing the possible connections with subscribers, and of these 243 are already filled up. Over each number is a small brass shutter, which keeps closed by a slight magnetic current, and is released and falls whenever the subscriber's bell is touched. Below the shutters are an equal number of holes, similarly numbered, for brass pegs, by which the wires necessary to complete the respective circuits are brought into connection. Two pegs are connected by short lengths of insulated wire, and when one peg is put, say, into hole 1, and the other into hole 10, the subscribers represented by these two numbers can converse. At the bottom of the upright board is another one, divided into three compartments, with pegs for connecting the more remote numbers without using too great a length of wire. The operators present a rather peculiar appearance, from having a handkerchief bound round their heads, as if they had been having a fight and got punished. The handkerchief, however, only binds a telephone on the ear of each, so as to leave the hands free, the speaking telephone being on either side of the board. Instead of bells, which would be maddening, ringing as they would violently all day, and sometimes half-a-dozen at once, there are instruments called "breaks," which simply make "burr" when the subscribers' bells are struck. It is the small shutters on which the eyes are fixed. One falls, and immediately the operator receives an order through the telephone at his ear to connect with So-and-so; he does this by means of the pegs in an instant, and as soon as the subscriber connected responds to the bell his shutter falls. The operator being satisfied that the two are in communication shuts up both shutters but they fall again when the speakers "ring off," and have to be shut again. Thus the operation consists—(1) In responding to the first request, "Yes," or "right," or perhaps "engaged at present"—for sometimes as many as five people want to connect with one firm at the same time, and of course it must be one at a time. (2) Putting in two pegs. (3) Shutting up the two shutters. (4) Taking out the pegs when "rung off," and shutting the shutters again. Generally these shutters require to be shut three times. Some delay is caused by a want of promptitude in giving the name or number required, and also in getting the response from the person to be spoken with, but, on the whole, the operation is carried out with surprising celerity. Monday is not usually a busy day, but every now and then the calls were very brisk, shutters flying open all over the board, and both the operators finding full employment for their practiced and rapidly moving hands. Thirteen couples were in conversation at one time. As they have no time to take down the numbers of those who apply for communication with persons already engaged, it cannot be expected that they can put the respective applicants "on" in succession in every case without a fresh call, but they do this very frequently. The chief and most experienced operator has the first 150 numbers under his charge, and as these include all the Bond street merchants, he has quite enough on his hands; the other, and younger operator, is not quite so much pressed, but is very prompt and ready. They both work eight hours daily—from 9 to 5—and well earn their subsequent rest. A nervous man engaged in such work would soon be in a lunatic asylum. On Saturday, as we were informed by the operator—being a wet day—everybody seemed to remain in his office, and for two hours every one seemed to want to talk to every one else. The calls were so incessant as almost to be beyond the powers of the operators, but this does not frequently happen. The average calls per diem amount to 2,000, which is considered very high for the number of instruments in use. The success of the telephone is undoubtedly in great measure due to the unpretending, but highly efficient, manner in which the instruments are worked at the head office, and to visitors the operation is highly interesting. The operators are as familiar with the names of subscribers as with their numbers, and rarely have to ask a question when the call is made. We do not know where a better idea of the business activities of Dunedin can be got than by a visit to the telephone room. We are evidently a "live" people. We have a great deal to say to each other, and don't take long to say it.

Sources of Electricity.

All the different classes and kinds of cell and battery in use are to be found under the heads that follow in the appended table, given by Sprague, who says: The question is frequently asked, which is the best battery? Each form has its special qualities, fitting it for particular operations, as the following classification shows:

Names and Classes of Batteries.

1 Leclanchè.
2 Law.
3 Bergman & Haid.
4 Chlorine.
5 Smee.
6 Daniell.
7 Nitric Acid.
8 Slater's Iron.
9 Bichromate.
10 " single cell.
11 Lime Chromate.
12 Manganese.
13 Lead Sulphate.
14 Mercury Sulphate.
15 Silver Chloride.
16 Magneto-Electric Machines.

USES CELLS ARE SUITED FOR.

Large Currents—Continuous—Electro deposition, 2, 1, 7, 3, 5; Gilding, 2, 1; Silvering, 2, 1, 7, 3, 4; Electro-Magnets, 7, 3, 4, 1, 2; Electric Light, 3, 7, 1.

Temporary—Induction coils, 6, 7, 5, 3; Medical coils, 6, 1, 7, 5; Medical coils, pocket, 11, 10, 8.

Small Currents and High Resistance—Large telegraphs, 2, 7, 8, 10, 12.

Occasional—Domestic bells and telegraphs, 8, 10, 9, 1; Exploding fuzes, 12, 8; Testing resistances, &c., 7, 5, 8.

The batteries of Grove and Bunsen are not used in England for telegraphic purposes; They have been tried on the continent, but in almost every place they have given way to the Daniell, the Leclanche, Law, or the Bergman & Haid. They were, until lately, used in America, but are now giving way to some form of the Daniel or Leclanche.

The use of Magneto Electric Induction Machines has, within the past few seasons, promised in time to replace all other sources of battery currents in Electric telegraphy. Magneto currents were employed in England in telegraphic service in 1865, but without satisfactory results. The greatest success in this direction has been demonstrated in the United States. In 1880, the Western Union, in their New York office, replaced their 19,000 cells with 15 Siemens Machines.

Electrical Review,

FORMERLY REVIEW OF THE

Telegraph and Telephone.

Published Weekly at 23 Park Row.

P. O. BOX 3329.

GEO. WORTHINGTON, Editor. THOS. H. DELANO, Publisher.

SUBSCRIPTION.

United States and Canada, $3.00 per annum, in advance.

Great Britain and other foreign countries, $4.00, in advance. Postage free.

ADVERTISING.

Transient rate, 25c. per line each insertion.

"Business specials," 35c. a line.

EDITORIAL ANNOUNCEMENT.

Address all communications and make all checks and P. O. orders payable to order of Delano and Company, Proprietors. P. O. Box 3329, New York.

We invite correspondence from Electricians, Inventors and the Telegraph and Telephone fraternity on matters pertaining to electrical and scientific subjects, and all facts of special interest in connection therewith.

We extend to manufacturers of electrical apparatus an invitation to send to this office any and all facts concerning their business which will be of interest to the public. We make no charge for publishing news.

Those desiring to recommend their goods can do so to any extent in our advertising columns, but we will not publish for pay anything of that nature in our reading columns.

Subscribers can at any time have the mailing address of their paper changed by sending both old and new address.

The Proprietors do not hold themselves responsible for opinions expressed by their correspondents.

No notice is taken of anonymous communications.

FOREIGN AGENTS OF THIS JOURNAL,

From whom copies of the paper can be procured.

The Montreal News Company, Montreal, Canada.
The Toronto News Company, Toronto, Ontario, Canada.
Wm. Dawson & Sons, London, England.
H. A. Kramer & Sons, Rotterdam, Holland.
Berthold Mendel, Berlin, Germany.
F D. Osborne, Calcutta, East India.
F. Knauff, Moscow, Russia.

NEW YORK, MARCH 6, 1884.

CONTENTS.

	PAGE
The Chesapeake and Potomac Telephone Co...	1, 2
The Electric Light in St. Paul, Minn.....	2
Electric Propulsion.....	2
Courting by Telephone.....	3
American Electric and Illuminating Company.	4
United States Electric Works.....	4
Electrical News.....	4, 5
Electricity.....	4
Telegraphic.....	5
Telephonic News.....	6, 7
Telephone Wires Cannot be Sunk.....	6
Underground Wires.....	6
Colonel Keller's Popularity.....	6, 7
Kansas City and Northwestern News.....	7
New Zealand Telephone News.....	7
Shall the Wire be Put Underground.....	8
Study of Sound and Telephony.....	8
A study of Physical Agents.....	8
Thunder and Lightning.....	9
Drawbaugh's Boom.....	9
Steam Distribution in Cities.....	9
The Wire Gauge and Weight of Wire.....	10
Electrical Patents.....	10
Business Notices.....	10
Average Market Quotations.....	10

Shall the Wires be Put Underground and Telephone Service Discontinued?

The usual fight is in progress at Albany to get a bill through the Legislature to compel telephone and telegraph companies to place their wires underground.

If it is advocated on æsthetic grounds, let any unprejudiced person compare a well-built line of telegraph poles with the awnings, posts, signs, and other genuine eyesores in the streets and on the buildings.

If on the ground of obstruction to the traffic, to what extent does the presence of a telegraph pole, even of the largest size, interfere with the use of the roads or streets for general traffic? Have any accidents ever occurred that can fairly be attributed to their presence? We think not. The best argument against any coercive legislation in this matter is the fact that in Europe, and especially in Great Britain, the highest electric talent in the world has been struggling with the underground problem for the past 25 years, and yet they have so far developed nothing that will meet the limited demands for telephone and telegraph service over there. The trials, difficulties and expense of underground wires are so great that W. H. Preece, the chief of the Postal Telegraph Department of Great Britain, speaks of what he calls the "senseless clamor" against overhead wires, and recommends some sort of legislation that will permit light wires to be placed on ornamental fixtures to be attached to the roofs in all large cities, to accommodate the necessary growth of the telephone business.

The American Bell Telephone Company have spent thousands of dollars on experimental underground work; the Western Union Company have done something; it is not fair, therefore, to say that the Telephone and Telegraph Companies refuse to place their wires underground simply on account of the expense. The telephone companies have reached a point, especially in all the large cities where underground wires would be a relief to the overburdened poles. It is a common thing to state that underground wires will cost but a trifle for maintenance and repairs, and yet there is very little to support this statement. The first underground wires, laid principally in England, failed from reasons partially attributable to lack of knowledge and experience; since then it has been proved that underground wires are not more lasting or durable than overhead. With gutta-percha there is a liability to decay, produced, it is supposed, by some vegetable parasites; or in dry soils it may crack. Other compounds have been suggested and invented for cheapening the cost, but the test of time in various soils can only determine their value. So far, nothing has equaled gutta-percha; yet every new inventor, because he can produce a cable that for the hour tests more or less perfectly, cries "Eureka," and thinks the problem solved.

Among other systems advocated is the Waring cable recently laid in Washington, and some of which is said to have been in service for 20 months in Pittsburg. The advocates of this cable boldly claim that it has none of the faults that appear in all other underground wires. But what are the real facts? Two gentlemen, well known in the telephonic and telegraphic field, visited Pittsburg for the purpose of examining this cable. It was claimed to have been buried some 20 months. In this brief space of time nine-tenths of the whole length was found so defective that the promoters were afraid to submit it to the tests that any electrical engineer would require before agreeing to use it. The serious fault of cross talk between two wires proved to be as bad as in any cable they had ever tested, and the working of a Morse line through one of the wires produced an inductive effect on the neighboring telephone wire sufficient to destroy all the comfort of the communication, if not the utility. Two years is a very brief period in which to test the durability of any insulating material, and the slightest deterioration in that time would be sufficient to arraign or condemn it. Telegraph or telephone companies would be as much pleased as the promoters should this cable prove to be not only the "Waring" cable, but a wearing cable. Time alone can solve this question.

The Study of Sound and Telephony.

Nothing is more important to those interested in telephony than the study of sound and sound waves, or the vibratory forces. In considering this subject, the action of vibrations in sound may be compared with their relations to other forces. A sound, when produced, leaves that which made it and passes quickly into the surrounding objects. The sound of a cannon, or of an explosion, not only passes into the ground but also into the trees and buildings which may lie adjacent. The ringing tones of the organ shake the building in which it is played.

We know from experimental research, says a writer in the English *Mechanic*, that the vibrations are transmitted through all substances at velocities which vary with the nature of the material. Farther, it has been found that mechanical force is resisted and produces heat by friction or condensation, and the mechanical force of the vibrations will be resisted, therefore, by the condensation and internal friction of the substances, and heat will be then produced in various proportions, according to the resistance. The heat again causes a change in the chemical properties of bodies, and it is with this effect that electricity is usually associated. In a mechanical vibration there is, then, three different effects: First, mechanical force; second, heat; third, chemical affinity; and these are in variable proportions according to the substance that the vibrations pass through, and the rapidity with which they are propagated.

The merest tyro in the study of the telephone and telephonic action is aware that it is constructed with a view to imitate the ear in taking cognizance of the various pulses of force, waves, or tremors within certain limits. The nature of things prevents a single wave of sound from ever coming alone. The more nearly alone a wave comes, the more sharp and sudden the sound. When several nearly equal waves come at irregular intervals, it produces a noise. When the waves are equal, and at equal distances, we get a musical tone. The middle C between the bass and the treble clef is produced by waves about eight feet and ten inches apart; waves at half that distance apart produce a tone one octave higher. If the distance apart of the waves of one note bears a simple ratio to the distance apart of the waves of another note, the two notes harmonize; otherwise they are discordant.

When, however, we come to chemical affinity, or, as it was once called, electric attraction, it is not so easy says an authority, to explain matters with any certainly, for the chemists have constructed an elaborate theory on the metaphysical supposition of atoms, and they are continually altering their theory to suit fresh experimental discoveries.

In the formation of water by combustion, he says the gases condense from three volumes to two; but in formation of carbonic acid there is no condensation; on the contrary, the solid carbon expands into a gas. The action of chemical affinity seems to be opposite at first sight; but we may consider it as expanding the oxygen into the hydrogen and the carbon into the oxygen, and in this way chemical affinity will be an expansive force. But in the case of ozone, the expansive nature of chemical affinity can be clearly shown, for it is a gas produced by electricity, which has greater specific gravity than oxygen. It has, therefore, less mechanical pressure against the atmosphere for a given weight of material; but this is compensated by increased chemical affinity at ordinary temperatures. Ozone is supposed by chemists to have the formula OO_2, and be denser than oxygen in the proportion of 3 to 2; but Andrews says it is $3\frac{1}{2}$ times heavier than oxygen, and the formula given may depend on some definite length of the electric spark, for a long spark produces more ozone than a short spark, and even if the formula OO_2 is correct for one kind of ozone, there is still a possible substance of one equivalent of ozone united to two equivalents of ozone, which may be produced by a sufficient length of spark; and this kind of condensation could continue until a substance of the same nature as ozone was produced with a chemical affinity that would enable it to burn of itself in the air. Again, the true form of flame is globular. This is proved by the form of a candle-flame in rarified air, or the flame of a thread under the ordinary atmospheric pressure. In both these cases the flame is in the form of a globe, because the gases produced expand faster than they can rise, or rather, they are too dense to rise till they have expanded.

We may, therefore, consider globular lightning as a substance like ozone, but more condensed, and burning on its outer surface until heat enough has been generated to detonate the interior into ordinary gas or ozone. In this case a phenomenon of electricity is explained by the expansive force of chemical affinity, and the ordinary principles of the combustion of gases.

A Study of Physical Agents.

The numerous letters received from different parts of the country from those who are devoting themselves to applied science, indicate that American workmen are no longer contented to remain ignorant of all but the application of the physical laws, and many of their questions show a determination to look higher and drink deeper in the mysteries of the natural forces.

Carried far enough this will lead, no doubt, in the future to the presence in this country of a body of men who shall devote themselves to the study of pure science; who will not be satisfied with the applause and gain begotten of putting into practical working order the ideas studied out by others without hope of reward.

That there is much of this work to be done no one will doubt who has made even cursory examination of the matter. Indeed it would require much boldness to affirm that that which we know compared with what is yet to be discovered is as one is to infinity.

We can measure and even weigh electricity and electric currents with as much ease as ordinary matter, yet have we made any approach to an explanation of the phenomenon of electricity? Light, we have been told, is an undulatory motion, and yet we have not discovered what it is that undulates. Heat is motion, but we do not know what it is that moves. Ordinary matter is a common substance, but who shall fathom the mystery of its internal constitution?

Heat we know is the name both of a certain primary sensation which can be defined only by its synonyms, warmth, calidity, &c., and also the name of the unknown agency or cause that produces the sensation, together with a great variety of phenomena in the material world. All bodies with which we are familiar are incessantly under the influence of this agent, its presence being an indispensable condition toward fitting the globe on which we are for the habitation of life and intelligence. Light, we know, is a name given first, to the yet unknown agent or cause of the illumination and visibility of bodies in nature, secondly to the conditions of bodies while acted on by such cause; and thirdly to the sensation arising from the reception of its influence upon the sensitive portion of the eye.

The question as to what science knows of the restorative energies of nature. However true, says an authority, this may be to the astronomer or even the natural philosopher, although as students of the infinite they might be credited with more exalted opinions of the powers of the human mind, the examination of any portion of terrestrial matter reveals to the chemist, there is concealed within it a form of energy whose power of expansion seems almost boundless. The various chemical compounds, which, on being exposed to heat or friction explode with varying rapidity and force, are examples of its action that cannot well be overlooked. The same authority says:

"And, although there are compounds so stable as to resist either for their decomposition, yet the existence of this expansive force within them is as undoubted as if it betrayed its presence by combustion or explosion. When the chemist endeavors to overcome the cohesion of these intractable substances, he accomplishes it by the addition of other elements of matter. Thus the action of aqua-regia on gold enables him to dissolve this most intractable substance, and a further addition of ammonia throws down a precipitate so unstable that the detonation of only a few grains is attended with tremendous energy. Now, he knows that the addition of nitrogen has not added to the amount of expansive force; there is the same quantity weight for weight in dynamite as in clay, and no more; but the power of cohesion to maintain the state of condensation in the dynamite, now nearly balanced by the presence of the condensed nitrogen, and the compound must be handled with caution. Precisely the same conditions are observed in all terrestrial substances. If a diamond is under examination he knows this piece of carbon, the hardest and most transparent of all solids, has nevertheless a hidden energy that would, if unopposed, expand it indefinitely. As the result of his analysis the chemist declares the existence in all terrestrial matter of two forms of energy, namely, a gravitating and condensing force, and a force of unlimited expansion; and, that in unvarying proportion, both are present in matter in all conditions, either solid, liquid, or gaseous. It remains for the astronomer to determine whether they exist in space dissociated from matter or not. Attraction of gravitation and the luminiferous ether pervade the universe; the question is whether matter in any form or condition is present with them."

As said before, we know that light is an undulatory motion, yet we do not know surely what it is that undulates. There are many, however, who are satisfied with the answer that light consists of the undulatory motion of an infinitely elastic substance pervading space. This, says an authority, was long considered the best explanation of the known phenomena of light until it was finally proved a fact by Fresnel's interference experiment. He says:

"The phenomena of polarization demonstrate that the vibrations of light are at right angles to the direction of the rays, by showing that whereas in a ray of ordinary light the vibrations are transversal in all directions to the line of propagation; they are, when completely polarized, vibrating in one direction only. The phenomena attending refraction have also shown, by the difference in the rapidity of propagation of light in various refracting media, as well as the amount of deflection its rays suffer in their passage through them, that the density of the luminiferous ether varies in different substances; whilst the phenomenon of double refraction, as shown by various crystalized substances, notably Iceland spar, demonstrates this density to vary in different directions in the same substance. Thus the velocity of light in air as compared with water is as 4 : 3; whilst in glass it is as 3 : 2. Light is therefore, propagated more slowly through strongly refracting than feebly refracting media, and formulates the law that the index of refraction between one medium and another is equal to the relation that the rapidity of propagation in the one medium bears to its rapidity in the other. The dispersion of light illustrates the remarkable fact that the luminiferous ether is not a simple but a compound substance, each component giving rays of different colors, different wave lengths, and different refrangibilities; so that in a color dispersing medium the various kinds of light are propagated with different velocities and consequently differently refracted."

This is one of the clearest demonstrations of the subject that we remember to have seen. If now we accept this as a correct interpretation of the true nature of the luminiferous ether, that it is a substance infinitely expansive and elastic, pervading the entire universe and contained in varying density by all natural substances, there remains for examination the cause of the vibrations called light. As to this an expert chemist says:

"The burning of magnesium in oxygen gives one of the most brilliant lights known, the product of combustion being the oxide of the metal. Now, the problem to be solved is the cause of the intense light. Before the solid metal can combine with the gas, it must itself assume the gaseous form. To enable it to do this it must be strongly heated to overcome the force of cohesion of its particles. This being effected, chemical affinity comes into play. The metal assumes the gaseous form, combines with the surrounding oxygen, and condenses into the solid white powder forming the product of the combustion. Observe the changes in the density of the materials and contained ether here described. First the solid metal expands into the gaseous form. This expansion is suddenly checked, and then, during or after chemical combination, as suddenly condenses into the solid form again. It is this sudden check to the expansion of the metal, followed by the condensation of both the chemically combined substances, which produce the brilliant light. A powerful vibratory motion is effected in the condensing ether by the sudden stoppage of the expansion and the instant condensation, the intensity of the vibration and the consequent brilliancy of the light being in proportion to the extent and velocity of the condensation.

Thunder and Lightning.

The question of thunder storms is an interesting one, especially to telephonists and telegraphists. It is curious to see how one after another the old beliefs regarding thunder storms are shown to be without foundation in fact. The farmer will tell you that thunder turns his milk sour because of the sulphur in the air. But we know, now, that there is no appreciable amount of sulphur in the air during thunder storms, and that it is ozone. Prof. P. G. Tait, of Edinburgh, who is an excellent authority upon such phenomena, says that the meteorological effects of a thunder storm arise from the extraordinary amount of vapor in the air, and the consequent immense fall of rain and hail. He says that to find out the amount of energy involved in changes of that kind makes a study of more than usual interest. In considering it, the results arrived at he looked upon as astounding. Then he goes on to say:

"To evaporate a tenth of an inch of water on a square foot of ground required a power equal to one horse for half an hour, so that to condense one-tenth of an inch of water on a square mile they would require one million million horses working for the same time. They had then no difficulty in understanding how it was that hurricanes and typhoons could be produced by the amount of energy in the heat formed out of that small quantity of water in condensing from the vaporous into the liquid form." Going on to speak of the three forms of lightning—forked, sheet, and globe—he said that forked lightning was simply the same thing, on an incomparably larger scale, as the sparks they got from the electrical machine; and that the "flash" was simply the air rendered incandescent by resistance to the passage of the electricity, in the same way that the carbon in the Swan lamp was rendered incandescent by a current of electricity being forced along it. A brilliant flash of lightning lasted, it was computed, only one millionth part of a second. Experiments had been made which went to show that a bright object required to be seen for one-tenth of a second before its real brightness was realized by the eye. If it lasted only half that time, it produced only half its brightness, and so on; consequently a flash of lightning was only seen at a hundred-thousandth part of its proper brightness. If a flash of lightning lasted the thousandth part of a second, objects would be as brilliantly illuminated by it as they were in the sunlight; and if it lasted one-tenth of a second it would have the brilliancy of 100 suns, and would be blinding in its effects.

Sheet lightning was merely the clouds and vapor in the air lighted up by a forked flash, which iself was hidden from view. And as to the curious phenomenon known as globe lightning, they knew little about it, as they had never been able to produce it by experiments; and it had never been observed by any trained observer.

The reason why such evident truths were not heretofore discovered is, there is reason to believe, to be found in the theories which, up to a comparatively recent period, were entertained by those from whom we looked to for explanation and investigation in this direction. Prof. Tait, rejecting most of the old beliefs, studied out the problem carefully and diligently, and his reasoning is founded for the most part in much more than theories, either ancient or modern.

Referring to thunder, he shows how it is caused by the sudden expansion of the air on all sides of the lightning flash, followed by an almost instantaneous inrush of air when the flash has passed. Thunder, he says, was never heard more than fifteen miles off from the flash of lightning; and he remarked that the popular way of judging the distance, of allowing a mile for every five seconds interval between the flash and the thunder, was nearly correct. The old notion that there was something sulphurous connected with the discharge of electricity in the air had been discovered to be incorrect. The sulphurous smell had nothing whatever to do with sulphur, but with the great production of ozone, which was merely a modified form of oxygen. As to the peculiar marks which lightning often left on a human body it had struck, the old notion was that they were a sort of photograph of some tree or object in the neighborhood which had attracted the lightning. These were, however, caused by a disturbance in the nature of bruising of the small capillary vessels under the skin. Dealing next with the difficult question of the origin of electricity, Prof. Tait remarked that the old idea that it was due to the friction of the air was untenable. A French investigator had suggested that every time water containing salt in solution was evaporated the vapor which came off was always charged with electricity. That, said the lecturer, was probably not far from true, though it was not the whole truth. His own idea at present was that electricity was caused by the friction of the water vapor particles against the air particles, because when two different bodies were in contact they always gave off electricity.

Steam Distribution in Cities.

Editor of the Electrical Review:

In an editorial article in your issue of January 31st, entitled "Gas the Fuel. Electricity the Light," you quote from a paper upon a claimed improvement in the manufacture of Water Gas, read before the "Institute of Mining Engineers," as follows:

"The latest experiments on a scale of some magnitude in our cities, in the way of heating buildings and furnishing power for manufacturing purposes, have been by the distribution of high-pressure steam through pipes laid in the streets. But these experiments (1) have not hitherto been very successful, and (2) when we consider the high cost, and (3) the great and unavoidable loss of heat and power, which always accompany the conveyance of high-pressure steam to any considerable distance, in pipes, to say nothing of (4) certain practical difficulties in the management of the pipes themselves, it is evident that all such methods must eventually disappear before a system which can furnish a cheap gas, of great heating power, easily distributed wherever wanted without requiring pipes to stand pressures of fifty to seventy-five pounds per square inch, and (5) without keeping the whole mass of ground in the streets through which it passes hot, grates, for a distance of ten to fifteen feet in all directions around the pipes."

The quotations contain at least four assertions, (indicated as 1, 2, 3, and 4) and one inference (5) not warranted by the facts.

The addition of the editorial opinion that "The fact is, as we have seen here in New York, this high-pressure steam business is not likely to prove either safe or profitable" is equally unjust to a great and growing enterprise, and calls for a statement of the facts, as they are, and as the writer will take pleasure in demonstrating them to be, to any person desirous of investigating the subject.

The writer of the paper read to the "Mining Engineers" may not have known that there were in New York city when he wrote, two steam distribution companies, one of which was an utter failure, physical and financial, while when he read his paper (in February, 1883,) the New York Steam Company had in successful operation three and one-half miles of main steam pipes, supplying steam of seventy-five pounds pressure to over one hundred consumers.

The company now has five miles of mains; is supplying our four thousand horse-power of steam to two hundred and fifty consumers; has been in successful operation since April 27th, 1882, a period of over twenty months, with less interruptions than the elevated railways, with less accidents or difficulties of any kind than a new railroad; and numbers among its consumers, such establishments as the New York *Tribune*, New York *Times*, New York *World*, *Iron Age*, the Produce Exchange, and the new Mutual Life Insurance Building.

The difficulties and objections named by the writer of the paper referred to, are such as attach to poorly constructed or improperly designed systems, but are not inherent in the problems of steam distribution in cities.

I agree with you that "Electricity is the Light" of the Future, and it may be that "Gas is the Fuel," but the abolition of steam for heating and power does not necessarily follow. The fact is that the problem of steam distribution in cities, is in a much more forward state at present than that of the production and distribution of water gas.

OFFICE OF NEW YORK STEAM CO., 22 Cortlandt St., New York. } WM. P. SHINN.

The Drawbaugh boom doesn't seem to be much of a boom after all. When we first heard the Drawbaugh people talk we made up our mind that they hadn't much of a claim to anything unless possibly it was to some new quality of brass, but, after listening to what they had to say, it became apparent that it were better to concede to them the telephone or any other thing they wished rather than be longer subjected to the repeated blast from their somewhat vociferous "bazoo."

When we saw the picture of Daniel Drawbaugh in the *Graphic*, together with a very fulsome, not to say tiresome, description of him and his undertakings, we thought we discovered good evidence of the presence of a colored gem'man on the fence.

It was a delightful story. If it hadn't been for the pictures and drawings we should have taken it for a beautiful picture of backwoods life. Here was the little winding road that led past the church-yard, past the little white church and yet more diminutive school-house, winding along toward the great chain of mountains, purple tinted in the waning daylight. Everything was lovely in that little Pennsylvania town. The houses were white, the skies were blue and the grass was green But Mr. Daniel Drawbaugh was neither white, blue nor green. He had been born white, but honest toil and a Pennsylvania sun had given him a swarthy complexion, the acquaintance of those famous jokers and jovial blades, the officers of the People's Telephone Company had prevented his being blue, and any one who had picked up Mr. Drawbaugh for a greenhorn discovered before he got through that he had made a serious mistake. To hear Mr. Drawbaugh tell his own story would bring the tears to the eyes of the most hardened wretch in the community, but the story when told by his friends of the so-called People's Telephone Company is better than Mark Twain's description of the discovery of America by Alexander Selkirk.

Regardless of the statute which governs patents, Drawbaugh lays claim to an apparatus that had been in public use more than the allotted two years. His friends when asked why he did not apply for a patent years before when he claims to have invented the telephone, answer that he was too ignorant to know its value, and too poor to pay for a patent if he had known it.

The Wire Gauge.

The ordinary numbers of wire were in common use in 1735 and still earlier, these numbers being originally based on the successive series of drawings—No. 10, for instance, having passed ten times through the draw plate, each reduction being supposed to be about 20 per cent. on the size preceding. The gauge sizes of the Washburn & Moen or Worcester gauge, and those of one of the numerous Birmingham gauges, that chosen being familiar in English telegraph service are as follows:

These wires shown, ranging from No. 1 to No. 16, comprise all the sizes known or required in the uses of electric service.

It should be understood that these gauge sizes are those of plain iron or steel wire. In each case good galvanizing should add about ¼ size to each number.

BIRMINGHAM AND WORCESTER GAUGES.

Gauge Numbers.	Size of Mils. .001 in.		Weight per mile, lbs.	
	B. W. G.	W. G.	B. W. G.	W. G.
1	.300	.283	1210	1121
2	.280	.263	1054	968
3	.260	.244	909	833
4	.240	.225	775	707
5	.220	.207	651	599
6	.200	.192	538	514
7	.185	.177	461	439
8	.170	.162	389	367
9	.155	.148	323	306
10	.140	.135	264	255
11	.125	.120	211	202
12	.110	.105	163	154
13	.095	.092	124	118
14	.085	.080	97	89
15	.075	.072	76	72
16	.065	.063	57	55

GROWTH OF THE U. S. TELEGRAPH SERVICE.

Year.	*Miles of Line.*
1848	2,000
1850	14,675
1853	17,583
1860	29,412
1866	53,403
1870	77,298
1877	111,652
1880	142,362

WORLD'S TELEGRAPH SYSTEMS.

The following is the organization of the telegraph in relation to other branches of public service in the countries named:

Great Britain.—The English Postal Telegraph represents a complete fusion between the post office and the general telegraph service, the British Government, in 1870, having purchased and since operated all the lines throughout the kingdom. Stamps used for postal and telegraphic service are identical. Each post office is an office of deposit for telegrams. The railway telegraph service retains its own distinct system, not open to commercial business.

Germany.—The postal service and the telegraph are distinct departments, under the general direction of the empire, in the Bureau of Communications.

Austria.—The post office and telegraph form one section of the Ministry of the Commerce.

Belgium.—The direction of the telegraph forms one of eight bureaus under the Department of Public Works.

Denmark.—The telegraph belongs to the Ministry of Finance.

Spain.—Forms one section of the general direction of posts and telegraphs under the Ministry of the Interior.

France.—A separate department under the Ministry of the Interior, the postal service belonging to the Ministry of Finance.

Italy.—An independent general direction belonging to the Ministry of Public Works.

Norway.—Belongs to department of Marine and Posts, the service generally independent from the post office.

Netherlands.—Belongs to Ministry of Finance, under a special bureau.

Portugal.—Attached to Department of Public Works.

Roumain.—The postal service and telegraph form one direction under Ministry of Interior.

Russia.—A government department, completely independent of the post office.

Servia.—A bureau in Department of Interior.

Sweden.—Completely distinct from post office, under a general director.

ELECTRICAL PATENTS

INDEX OF INVENTIONS FOR WHICH LETTERS PATENT OF THE UNITED STATES WERE GRANTED IN THE WEEK ENDING FEBRUARY 26, 1884.

294,008 Electric fire-alarm and fire extinguisher system; Charles E. Buell, New Haven, Conn.

294,027 Electric arc lamp; Warren P. Freeman, Brooklyn, N. Y., assignor to William F. Jobbins, same place.

294,030 Railway signal; Oscar Gassett, Boston, Mass., assignor to the Union Switch and Signal Company, Pittsburgh, Pa.

294,038 Regulator for dynamo-electric machines; William Hochhausen, NewYork, N. Y.

294,039 Regulator for dynamo-electric machines; William Hochhausen, New York, N. Y.

294,040 Regulator for dynamo-electric machines; William Hochhausen, New York, N.Y.

294,041 Automatic brake for electric motors; William Hochhausen, New York, N. Y.

294,042 Double electric arc lamp; William Hochhausen, New York, N. Y.

294,043 Dynamo-electric machine; William Hochhausen, New York, N. Y.

294,044 Incandescent electric lamp; William Hochhausen, New York, N. Y.

294,045 Hanger-board for electric lamps; William Hochhausen, New York, N. Y.

294,066 Electro-magnetic machine; John W. Nystrom, Philadelphia, Pa.

294,094 Dynamo-electric machine; Elihu Thomson, New Britain, Conn.

294,095 Electric power distribution system; Elihu Thomson, New Britain, Conn.

294,131 Secondary electric clock; Vitalis Himmer, New York, N. Y., assignor by mesne assignments to Joseph Koenigsberg, St. Louis, Mo.

294,132 Electric device for synchronizing clock pendulums, Vitalis Himmer, New York, N. Y., assignor by mesne assignments to Joseph Koenigsberg, St. Louis, Mo.

294,148 Electrical conductor; Frank L. Pope, Elizabeth, N. J., assignor to the Postal Telegraph and Cable Company, of New York.

294,165 Motor for electric regulators; Charles J. Van Depoele, Chicago, Ill.

294,169 Regulator for dynamo-electric machines; Addison G. Waterhouse, New York, N. Y., assignor by mesne assignments to the Schuyler Electric Light Company, same place.

294,170 Automatic regulator for dynamo-electric machine; Addison G. Waterhouse, New York, N. Y., assignor by mesne assignments to the Schuyler Electric Light Company, same place.

294,180 Regulator for dynamo-electric machines; Charles E. Ball, Philadelphia, Pa.

294,195 Electric alarm for steam gauges; Harvey Carley and Thomas McKenna, Long Branch, N. J.; said Carley assignor to said McKenna.

294,212 Electric annunciator; Isaiah H. Farnham, Portland, Me., assignor to the American Bell Telephone Company.

294,259 Circuit-closer for telegraphic instruments; Julius Neifing, Dyer, Ind.

294,270 Commutator for dynamo or magneto-electric machines; Frank B. Rae and Clarence L. Healy, San Francisco, Cal.

294,294 Double electric arc lamp; Addison G. Waterhouse, New York, N. Y., assignor by mesne assignments to the Schuyler Electric Light Company, same place.

294,297 Telephone support; George A. Wilkins, Philadelphia, Pa.

294,307 Regulator for dynamo-electric machines; Charles L. Buckingham, New York, N. Y.

294,335 Galvanic battery; Owen C. Dalhousie Ross, 50 Trafalgar Road, County of Surrey, England.

294,336 Telephone circuit; Charles E. Scribner, Chicago, Ill.

A printed copy of the specification and drawing of any patent to the annexed list, also of any patent issued since 1865, will be furnished by any of the patent solicitors whose advertisements appear in this journal. In ordering please state the number and date of the patent desired.

The output of the Bell Telephone Company for the month ending Feb. 20 was 2,799, or 460 instruments less than for the previous month, and about one-half as many as for the corresponding month a year ago. The aggregate number of instruments now in use and put out by this corporation is something over 306,000.

WANTED.—First-class men on burglar alarm, hotel and house annunciator work; also first-class electrical instrument makers in western city. Permanent positions to right men. Address, with reference, giving experience, D., care Electrical Review, 23 Park Row, N. Y.

BUSINESS NOTICES.

A. C. NORTHROP, Waterbury, Conn. Iron and Brass Machine Screws, Zinc in Sheets and Plate for Electrical Purposes, Parts for Telephone and Telegraph Instruments, Manufactured from Iron, Brass, Steel or Zinc.

A. G. DAY, Kerite Insulated Telegraph and Telephone Wire and Cables, Anti-induction Kerite Telephone Cables, CLARKE B. HOTCHKISS, New York. Send for circular and prices.

ALFRED F. MOORE, Philadelphia, Pa. Telegraph, Telephone, Electric Light, Office, Line and Annunciator Wire.

AMERICAN BELL TELEPHONE Co., Boston, Mass. Electric Speaking Telephones for Exchange Systems, Private Lines, and Speaking-tube Lines.

AMERICAN ELECTRICAL WORKS, Providence, R. I. Patent Finished Insulated Electric Wires, Telephone and Electric Cordage. Electric Light Wire, Magnet Wire, Patent Rubber covered Wire, Aerial and Underground Cables, &c., &c. Send for prices.

AMERICAN SPIRAL TELEPHONE WIRE Co., Boston, Mass. Spiral Telephone Wire for long and short distance Telephoning. Write for information.

ARMINGTON & SIMS, Providence, R. I. Engines for Electric Lighting and general use.

AUSTIN GALLAGHER, New York. Keith Electric Light System complete for Arc Lighting. Stock for sale.

BAXTER ELECTRIC LIGHT COMPANY, New York. The Baxter Lamp.

B. W. PAYNE & SONS, Corning, N. Y. The Payne Single and Double Valve Automatic Engine. Send for catalogue.

BERGMAN & Co., New York. The Bergman and Haid Battery for Telephone and Telegraph purposes. Send for circular.

BOULTON CARBON Co., Cleveland, Ohio. Carbons for Electric Light purposes. Send for quotations.

BROWNLEE & Co., Detroit, Mich. Telegraph and Telephone Poles.

BRUSH ELECTRIC Co., Cleveland, Ohio. Arc Lights and Brush Storage Batteries.

BUFFALO ELECTRIC WORKS, Buffalo, N. Y. Carbon Points and Plates.

BUTLER SAFES, New York. Fire and Burglar-Proof.

CHARLES WILLIAMS, JR., Boston, Mass. Call Bells, Electric Bells, District Bells, Switch Boards, Annunciators, &c., &c. Write for quotations.

CHICAGO INSULATING Co., Chicago, Ill. The Fiske-Mott High-resistance Insulator. Send for circular.

CHROME STEEL WORKS, Brooklyn, N. Y. Steel for Magnets a specialty; Chrome Cast Steel.

COE BRASS Co., Torrington, Conn. Brass, Copper and German Silver in every variety of Sheets, Rolls, Plates, Wire, Rods and Blanks or Shells. Pure Lake Superior Copper Wire and Battery Zincs. Write for price list.

C. V. STAFFORD & Co., Acton, Ont., Canada. Telegraph and Telephone Poles.

D. VAN NOSTRAND, New York. Scientific Books. Send for circular.

ELECTRICAL DEVELOPMENT COMPANY, Boston, Mass.

ELECTRIC GAS LIGHTING Co., Boston, Mass. Improved Electric Gas Lighting Apparatus.

ELECTRIC STORAGE AND LIGHT Co., Boston, Mass. Own patents for Faure's Storage Batteries for territory of Rhode Island, Connecticut and Massachusetts.

H. M. RAYNOR, New York. Platinum for all purposes.

HOLMES, BOOTH & HAYDENS, New York. Fireproof Electric Light Wire, Patent "KK" Insulated Copper and Iron Wire for Telephone and Telegraph use. Send for catalogue and prices.

I. W. COLBURN & Co., Fitchburg, Mass. Dynamo Electric Machines.

IVISON, BLAKEMAN & TAYLOR, New York. Ink of all kinds and colors. Circulars sent on application.

JARVIS ENGINEERING COMPANY, Boston, Mass. Boilers set with the Jarvis Patent Furnace.

JOHN H. MUEGGE, New York. Platinum, Chemical Apparatus, Crucibles, etc.

LECLANCHE BATTERY COMPANY, New York. The Great Telephone Battery. Write for description and prices.

J. H. BUNNELL & Co., New York. The Morse Learner's Instrument, Telegraph Instruments of all kinds, Telephone and Telegraph Supplies. Illustrated Works on Electrical Measurement, and the Galvanometer and its uses. Send for catalogue.

LAW TELEGRAPH Co., New York. The Law Battery for Telephone and Telegraph purposes.

LOCKWOOD & FOSTER, New York. Learners' Telegraph Instrument.

MUTUAL DISTRICT MESSENGER Co., Boston, Mass. Addressing and Distributing Circulars &c., &c. D. J. Hern, General Manager.

NEW ENGLAND BUTT COMPANY, Providence, R. I. Braiding Machinery for covering Telegraph, Telephone and Electric Light Wire, Single and Double Winders and Braiders of every description; also Fine Castings. Send for catalogue.

O. W. MADDAUS, New York. Designer and Engraver.

PAINE & LADD, Washington, D. C. Attorneys in Patent Causes, and Solicitors of Patents.

PALMER WIRE Co., Palmer, Mass., and New York. Galvanized Telephone and Telegraph Wire Iron and Steel Wire of best quality, Material, finish and conductivity. Write for quotations.

PARTRICK & CARTER, Philadelphia, Pa. Electric Annunciators, Learners' Instruments, Batteries and Telegraph and Telephone Supplies. Write for circulars.

PHOSPHOR BRONZE SMELTING Co., Philadelphia, Pa. Telephone Wire, insulated and bare.

RHODE ISLAND TELEPHONE & ELECTRIC Co., Providence, R. I. Manufacturers of the Providence Telephone Switch Boards, Breckenridge Jacks, Wright Cable Clips, Howard Safety Appliances, &c.

SCHLEICHER, SCHUMM & Co., Philadelphia, Pa. Manufacturers of the Otto Gas Engine. Write for catalogue.

STANDARD ELECTRICAL WORKS, Cincinnati, Ohio. Manufacturers of Telegraph and Telephone Instruments, Magneto Bells, Switch Boards and Telephone Exchange Apparatus, Annunciators, Wire, Batteries, Insulators, Electric Light Wire and Supplies. Send for circular and prices.

SWAN INCANDESCENT ELECTRIC LIGHT Co., New York. Incandescent Lights, and Complete Apparatus. Send for illustrated catalogue.

THE ANSONIA BRASS AND COPPER Co., New York. Pure Electric Copper Wire for Magnets, Telephone Lines, and Electric Light purposes, Office Wire, Zinc Rods and Battery Copper.

THE BISHOP GUTTA PERCHA WORKS, New York, Gutta Percha Insulated Submarine Telegraph Cables Subterranean Telegraph Cables, Aerial Telegraph Cables, Lead or Hempen covered Torpedo Cables, Lead-covered Cables, Telephone Cables of all kinds —G. P. Office Wire, and Marks' Compound Insulated Wire, &c., &c. Send for catalogue.

T. H. ALEXANDER, Washington, D. C., Solicitor and Counselor in Patent cases.

THOMPSON-HOUSTON ELECTRIC LIGHT Co., Boston, Mass. Automatic Self-regulating System of Arc Lighting.

THE ELECTRICAL SUPPLY Co., New York. Electric Light, Telephone and Telegraph Supplies. Send for price list and catalogue.

TRENTON IRON Co., Trenton, New Jersey. Galvanized Iron and Steel Wire of all kinds for Telephone and Telegraph purposes. Write for prices.

TROPICAL AMERICAN TELEPHONE COMPANY, Boston, Mass. Telephones and Telephonic apparatus, for Mexico, Central America, West India, and South America.

UNITED STATES ELECTRIC LIGHT Co., New York. Arc and Incandescent Lights, complete and reliable systems, &c. Write for information.

UNION ELECTRIC MANUFACTURING Co., New York. Manufacturers of all kinds of Telegraph, Telephone and Electric Light Apparatus. Send specifications.

VIADUCT MANUFACTURING COMPANY, Baltimore, Md. Electrical Goods of every description. Electric Light and American District supplies. Send for price-list.

VICTOR, BISHOP & Co., New York. Platinum for all Manufacturing, Chemical and Electrical purposes. Send for prices.

WESTERN ELECTRIC Co., New York, Boston, and Chicago. Telegraph and Telephone Apparatus and Supplies of every description. Send for catalogue.

WM. A. HARRIS, Providence, R. I. The Harris-Corliss Steam Engines and Light and Heavy Castings.

WATTS, CAMPBELL & Co., Newark N. J. Improved Corliss Steam Engines. Send for catalogue.

W. R. POPE & Co., Baltimore, Md. Telegraph, Telephone, and Electric Light supplies. The best of everything, and at lowest prices.

NATIONAL ELECTRIC COMPANY. Washington, D. C. Electrical supplies and apparatus.

ROYCE & MAREAN, Washington, D. C. Dealers in Electrical apparatus, Telegraph and Telephone supplies.

Average Market Quotations of Battery Supplies for the Week Ending February 28, 1884.

Leclanche Disque Cell, complete	$1.25
" Prism " "	$1.67
" Prisms, per pair	$1.00
" Carbon Mounted	30c.
" Jar Cover	12c.
" Sal Ammoniac, in bag	8c.
" Porous Cell	$1.10
" Glass Jar	18c.
" Amalgamated Zinc	10c.
" Rubber Bands, per pair	6c.
Chlorine Battery, per cell	$1.25
Law Battery, per cell	$1.25
" Jar and its Rubber Ring	25c.
" Cover, with small Carbon sealed in	35c.
" Large Carbons, each	20c.
" Carbon Connector	12c.
" Zinc Connector	8c.
" Rubber Bolt	12c.
" Zinc and its Rubber Ring	12c.
Bergman & Haid, per cell	$1.20
Crow foot, 6x8, per cell	75c.
Callaud Zincs	30c.
" Coppers	18c.
" Jars	25c.
Sal Ammoniac, per lb	15c.
Blue vitriol, per lb	10c.
" " bbl., lots, per lb	5½c.
Sulphate of zinc	10c.
Battery syringe	$1.90c.
Battery brush	20c.
Hydrometer	50c.

Send to our advertisers for price lists.

Average Telephone Stock Quotations, for week ending February 21st, 1884.

	Highest.	Lowest.
American Bell Telephone Co.	179	172
Central New York Telephone and Telegraph Company	168	97
Empire State Telephone and Telegraph Company	198	189
Hudson River Telephone and Telegraph Company	100	92
New York and New Jersey Telephone Company	86	74
Mexican Telephone Company	2½	2½
New York and Pennsylvania Telephone Company	76	67
Southern Bell Telephone and Telegraph Company	125	120
Tropical Telephone Company	2	2½
Central Union Telephone Co.	100	95
Iowa Union " "	100	95
Missouri and Kansas Telephone Co.	98	94
United Telephone Co. (Kansas and Missouri)	99	95
Bell Telephone Company, of Missouri	160	150
Wisconsin Telephone Company	120	115
Cumberland Telephone Co	100	97
Great Southern Telephone Co.	100	95
Michigan Telephone Company	105	100
Chicago Telephone Company	282	280
Erie Telephone Company	41	36
Union Telephone Company	100	95
Southern New England Telephone Company	165	160
New England Telephone Co.	53	46
Chesapeake & Potomac Tel. Co.	100	97

ROYCE & MAREAN,
DEALERS IN
ELECTRICAL APPARATUS,
Telegraph and Telephone Supplies,
No. 1408 Penna. Avenue,
Opp. Willard's Hotel, **WASHINGTON, D. C.**
Correspondence Solicited.

National Electric Company,
ELECTRICAL SUPPLIES AND APPARATUS,
1413 G STREET, WASHINGTON, D. C.
Estimates furnished. Correspondence solicited.

T. H. ALEXANDER,
Solicitor and Counsellor in Patent Causes,
607 7th St., Washington, D. C.,
OPPOSITE PATENT OFFICE.
Twenty-three Years' Practice.
Expert examinations and opinions, relating to infringements, Validity and Scope of Patents, Caveats, Designs, Trade-Marks, European and Canadian Patents. For information on Patent matters, send stamp for my "HINTS TO INVENTORS."

PAINE & LADD,
HALBERT E. PAINE, Late Commissioner of Patents. STORY B. LADD.
Attorneys in Patent Causes
And Solicitors of Patents,
WASHINGTON, D.C.

THIRD EDITION NOW READY.
ELECTRICITY
In Theory and Practice,
Or the Elements of Electrical Engineering
BY
Lieut. BRADLEY A. FISKE, U.S.N.
PRICE $2.50.
8vo, Cloth, 180 Illustrations.
Copies sent postpaid by mail, on receipt of price.
D. VAN NOSTRAND, Publisher.
23 Murray and 27 Warren Streets, NEW YORK.
Complete Catalogue of Electrical Books will be sent to any address on application.

INCANDESCENT LAMP WANTED.
Inventors of Incandescent Lamps wishing to sell patents can send description, terms, and specimen lamp to H, care of ELECTRICAL REVIEW, 23 Park Row, New York.

SPENCERIAN INK
Extra Black, Blue Black, and Copying, all of superior quality, claiming Special excellence in the essentials of Fluidity, Color and Durability. Circulars free.
Ivison, Blakeman, Taylor & Co., N. Y.

ИЛЛЮСТРИРОВАННЫЕ КАТАЛОГИ
EXECUTED IN FIRST CLASS STYLE AND WITH DESPATCH
O.W. MADDAUS
DESIGNER AND ENGRAVER ON WOOD
23 PARK ROW NEW YORK

MUTUAL DISTRICT MESSENGER COMPANY,
—) OF BOSTON. (—
Principal Office, Old State House, State Street, Boston, Mass.
J. M. PRENDERGAST, President,
D. J. HERN, Gen. Manager. W. H. SMITH, Sup't
DEPARTMENT FOR THE
Addressing and Distribution of Circulars.
NOTICE TO ADVERTISERS AND OTHERS.
We have in our employ experienced persons to address, fold and envelope advertising matter for distribution by mail or by our messengers.
We distribute Circulars, Handbills, Notices, etc., properly, and at less rate than can be done by any other manner, considering the thoroughness of our work.
Special arrangements made for any respectable kind of service; well drilled and neatly uniformed messengers employed to do the same. Will furnish estimates for delivering circulars, etc., to any city or town in Massachusetts.
OUR RATES FOR DELIVERY IN BOSTON ARE AS FOLLOWS:

Handbills, delivered on the Street,	$1.00 per 1000
" " in the Stores,	1.50 "
Unaddressed Circulars, (in envelopes)	3.50 "
" " 5,000 to 5,000,	$5.00 "
Addressed Circulars,	7.00 "
" " 2,000 to 10,000,	6.00 "
" " 10,000 to 25,000,	5.00 "
Pamphlets, (small), delivered on Street	4.50 "
" " in Houses	6.50 "
" (large). on Street	6.00 "
" " in Houses	8.00 "

Our price for addressing, folding, and mailing, (including envelopes and postage) is $20.00 per thousand for ordinary circulars of not more than 2 ounces. Special rates on lots above 10,000, and on books and other heavy advertising matter.

W. R. POPE & CO.
Corner North & Lexington Streets,
BALTIMORE, MD.
Telegraph, Telephone and Electric Light Supplies.
THE BEST OF EVERYTHING
AND AT LOWEST PRICES.

THE
Long Scented Telephone

(Patent Applied for),
The Great Novelty of the Age, and Toilet Article,
NON-ELECTRIC TELEPHONE.
Sold outright for two dollars per set. Address all orders to J. A. SEELEY, General Manager.
LONG SCENTED TELEPHONE CO.,
191 E. SEVENTY-SIXTH ST.,
NEW YORK CITY.

THE MILITARY TELEGRAPH
DURING THE CIVIL WAR.
BY WILLIAM R. PLUM, LL.B.
Two Volumes, Cloth, Illustrated, $5.00
DELANO & COMPANY, Publishers,
No. 23 PARK ROW,
P. O. Box 3329. **NEW YORK.**

The principal New York office of the Palmer Wire Company will be found hereafter at No. 15 Cortlandt Street, Room 20, Smith Building, four doors from Broadway. Frank B. Knight, general agent.

The Ansonia Brass & Copper Company of New York, is now manufacturing what it calls "acme bronze" wire, especially for telegraph and telephone purposes, which is highly spoken of. Lake Superior copper is used in its construction.

Neatly-bound volumes (half-yearly) of the ELECTRICAL REVIEW will be sent, postage prepaid, on receipt of $3; also the latest improved self-binders for the ELECTRICAL REVIEW, or any other electrical or scientific journal published in this country, for $1. Delano & Company, publishers, 23 Park Row, New York, N. Y.

WANTED.
Four live, young, practical telephone men as managers, Minnesota and Dakota exchanges, averaging one hundred subscribers. Bond of $500 required. Work required: Construction and repairs, collections, and night operator. Apply, giving references, experience, and salary expected, to A. C. Temple, Genl. Supt. Erie Telegraph and Telephone Co., Minneapolis, Minn.

BERNHARD LISSER,
S. 14 NEU KOLLN WASSER,
Berlin, Germany,
Is prepared to represent the best Electrical and Technical Corporations in Germany.
Will sell good Patents and import Electrical Goods.
Large, beautiful Rooms with Engine Power for Exhibitions.
—BEST OF REFERENCES.—

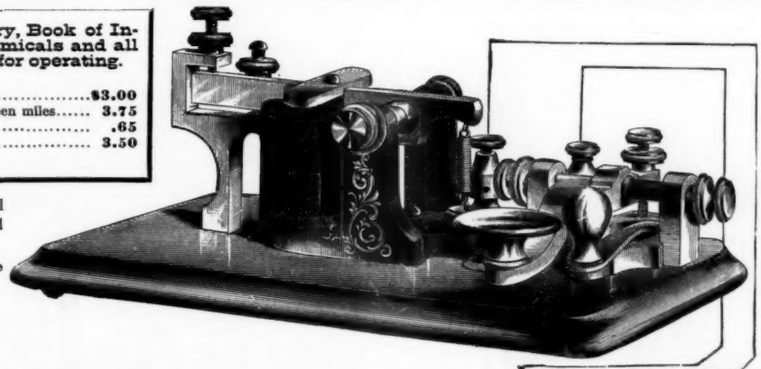
THE TROPICAL AMERICAN TELEPHONE CO., (LIMITED.)
SOLE AUTHORIZED EXPORTERS OF
Patented Telephones & Telephonic Apparatus
FROM THE UNITED STATES TO SOUTH AMERICA, CENTRAL AMERICA, MEXICO, AND THE WEST INDIA ISLANDS.
No. 95 Milk Street, Boston, Mass., U. S. A.

THE "MORSE" LEARNERS' INSTRUMENT THE BEST.

Price $3.75 complete with Battery, Book of Instruction, Wire, Chemicals and all necessary materials for operating.

"Morse" Instrument alone, without battery	$3.00
"Morse" Instrument without battery, and wound with fine wire for lines of one to fifteen miles	3.75
Cell of battery complete	.65
"Morse Learners' Instrument without battery, sent by mail	3.50

(Battery cannot be sent by mail.)



☞ Goods sent C. O. D. to all points if one-third of the amount of the bill is sent with the order. Remit by Draft, Postal Money Order, or Registered Letter. Favorable arrangements made with Agents everywhere.
☞ **We will in every case refund any remittance made us for these goods, if they are not found to be entirely satisfactory.**

You are sure of getting the BEST THAT IS MADE if you select the "MORSE."

The "Morse" is a full size, well made, complete **MORSE TELEGRAPH APPARATUS, of the latest and best form for learners, including handsome Giant Sounder and Curved Key, and a large Cell of the best Gravity Battery, latest form.**

IT IS THE BEST WORKING SET OF LEARNERS' INSTRUMENTS FOR SHORT OR LONG LINES, FROM A FEW FEET UP TO TWENTY MILES IN LENGTH, YET OFFERED.

J. H. BUNNELL & CO.,
No. 112 Liberty Street, New York.

NOW READY.

Electrical Measurement AND The Galvanometer and Its Uses.

BY T. D. LOCKWOOD.

144 pages, handsomely bound, large clear type, and fully illustrated with diagrams of connections, engravings of apparatus, etc. Price, $1.50. Sent by mail, Postpaid, to any Address upon receipt of price.

Every Telegraph Office Manager, or Telegraph Operator, every Telephone Central or District Telegraph Manager, every Student of Electrical Science, every person having charge of Electric Light Plant, or other Electrical Arrangements and Apparatus, and every person who takes an interest in Electrical Matters of any kind, should read

T. D. LOCKWOOD'S

"Electrical Measurement and the Galvanometer."

It is the only book which EXPLAINS in PLAIN ENGLISH and without algebraic formulæ all about Electric Measurement and the Use of Galvanometers, besides giving fully detailed and illustrated description of

GALVANOMETERS & RHEOSTATS,

with all diagrams of connections required in using them, and the plain and simple reason why for everything.

In this remarkable book the whole subject of Electrical Measurement is made so clear and plain that ANY ONE can easily understand every explanation, and can practically make electrical measurements without difficulty, and especially without "doing" sums in algebra.

PUBLISHED BY

J. K. BUNNELL & CO.

112 Liberty Street, New York.

TO WHOM ALL ORDERS SHOULD BE SENT.

THE ELECTRIC STORAGE AND LIGHT CO.

95 Milk St., Boston, Mass.

Organized under the Laws of Massachusetts,

OWN THE PATENTS FOR

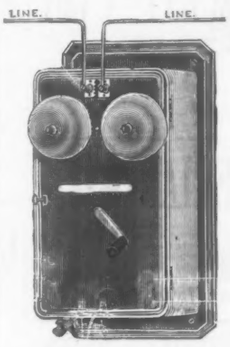
Faure's Storage Batteries,

OR

Electrical Energy Accumulators,

FOR

MASSACHUSETTS, RHODE ISLAND AND CONNECTICUT.



Viaduct Manufacturing Co.

OF BALTIMORE.

(Successors to late firm of DAVIS & WATTS.)

A. G. DAVIS, President.

ELECTRICAL GOODS OF EVERY DESCRIPTION.

Telephone, Telegraph, Electric Light and American District Supplies.

SEND FOR ILLUSTRATED CATALOGUE,

MAGNETO SIGNAL BELLS.

NO BATTERY REQUIRED.

$4, to $6, each. Discount on large lots.

STANDARD ELECTRICAL WORKS,

—MANUFACTURERS OF—

Telegraph and Telephone Instruments,

EXCLUSIVE MANUFACTURERS AND PATENTEES OF THE

"CELEBRATED POST" (NEW GEAR WHEEL) MAGNETO BELL,

Manufacturing Licensees of the AMERICAN BELL TELEPHONE COMPANY,

Magneto Bells, Switch Boards and Exchange Apparatus,

MANUFACTURERS OF

House and Hotel Annunciators, and Burglar Alarms, &c., Same Furnished and Put up to Plans and Specifications,

LARGE STOCK ON HAND OF

Wires, Batteries, Insulators, Electric Light Wire and Supplies.

Send for Illustrated Catalogue and Special Prices,

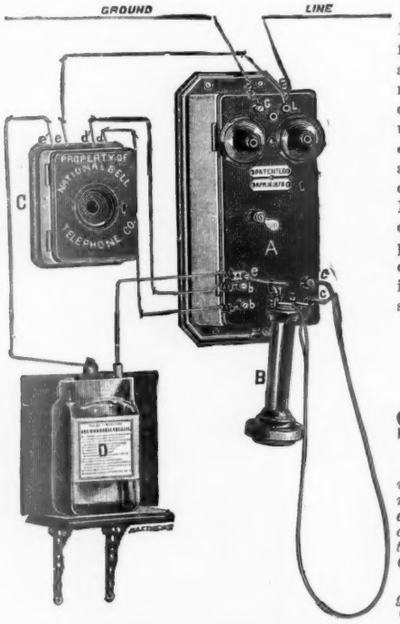
STANDARD ELECTRICAL WORKS,

Cincinnati, Ohio, U. S. A.

THE

American Bell Telephone Co.

WM. H. FORBES, *President.* THEO. N. VAIL, *Gen'l Manager.* WM. R. DRIVER, *Treasurer.*



This Company owns the Original Patents of Alexander Graham Bell for the Electric Speaking Telephone, and other patents, covering improvements upon the same, and controls, except for certain limited territory, under an arrangement with the Western Union Telegraph Co., the Gold and Stock Telegraph Co., the American Speaking Telephone Co., and the Harmonic Telegraph Co., the Patents owned by those Companies, and is prepared to furnish telephones to the citizens of the United States through its local Licensees, on the following systems:

EXCHANGE,
PRIVATE LINE, &
SPEAKING TUBE LINES

Those desiring instruments on Private or Speaking Tube Lines, or connections on Exchanges, will please apply to the nearest Licensed Exchange, when their case will be brought to the attention of the proper local Company.

Any further information will be gladly furnished on application to the Company at its office,

No. 95 MILK STREET, BOSTON, MASS.

All persons using telephones not licensed by this Company, are hereby respectfully notified, that they are liable to prosecution, and for damages for infringement, and will be prosecuted according to the full extent of the law.

THE THOMSON-HOUSTON ELECTRIC CO.

Principal Office, 131 Devonshire St., Boston, Mass.,

FURNISHES THE

ONLY PERFECT AUTOMATIC, SELF-REGULATING SYSTEM OF ELECTRIC ARC-LIGHTING IN THE WORLD.

In all desirable qualities of ELECTRIC ARC LIGHTS the THOMSON-HOUSTON SYSTEM has no equal. The Lights are *superior in color and steadiness*, and the entire apparatus is more *economical*, *efficient* and *safe*, more *easily managed*, and *less liable to derangement* than any other.

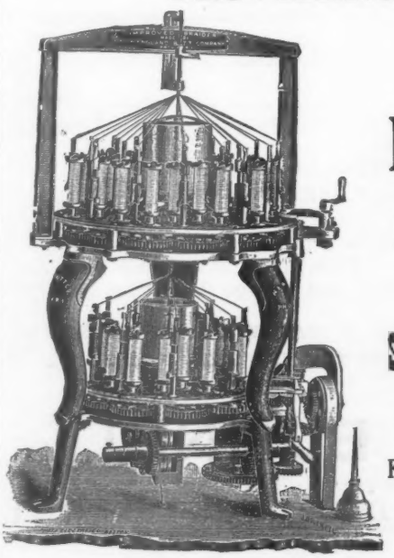
THE THOMSON-HOUSTON ELECTRIC CO. was awarded the FIRST PRIZE for the *best system* of arc lighting, and the *best Arc Lamp*, at the Cincinnati Industrial Exposition of 1883.

The Thomson-Houston System has been awarded *superiority in all the competitive tests* to which it has been subjected. NEW ILLUSTRATED PAMPHLET will be sent on application.

NEW ENGLAND BUTT CO.

PROVIDENCE, R. I.

MANUFACTURERS OF



BRAIDING MACHINERY

FOR COVERING

Telegraph, Telephone and Electric Light Wire

ALSO

SINGLE AND DOUBLE WINDERS

AND

Braiders of every description,

For Silk, Worsted and Cotton Braid,

FINE CASTINGS

A SPECIALTY.

The Coe Brass Mfg. Co.

MANUFACTURERS OF

BRASS,

Copper & German Silver,

IN EVERY VARIETY OF

SHEETS, ROLLS, PLATES, WIRE, RODS & BLANKS OR SHELLS,

Pure Lake Superior Copper Wire

A SPECIALTY,

BATTERY ZINCS.

TORRINGTON, Litchfield Co., CONN., U. S. A.

THE PAYNE

Single and Double Valve Automatic Engine.

Will guarantee 20 per cent. better regulation with our *single slide valve automatic engine* than can be attained by any other engine in the market. For sale by E. P. Hampon & Co., 36 Cortlandt St., N.Y., Hill, Clark & Co., Boston, Mass. Write for Circular No. 36. B.W. Payne & Sons. Box 1450, Corning, N.Y.

MAGNET STEEL

AND ALL KINDS OF

CHROME CAST STEEL.

STEEL for MAGNETS

A SPECIALTY,

And warranted superior to all other brands

CHROME STEEL WORKS,

Brooklyn, E. D., N. Y.

S. H. KOHN, *Proprietor.* C. P. HAUCHIAN *Superintendent.*

CHARLES WILLIAMS, JR.

[Established 1856.]

Nos. 109-115 COURT ST., BOSTON, MASS.

—AUTHORIZED MANUFACTURER OF—

THE AMERICAN

BELL TELEPHONE CO.

Magneto, Crank and Push Button

CALL BELLS,

ELECTRIC BELLS,

DISTRICT BELLS

AND

Switches for Exchanges, Annunciators, &c.

Telegraph and Electrical Instruments, Batteries, Wire, Insulators, and Telephone Supplies of every description

---

JARVIS ENGINEERING CO., BOSTON.

Boilers Set with the Jarvis Patent Furnace to burn Pea Coal, Screenings or Slack without a blower. Send for Circulars.

The Buckeye Automatic Cut-Off Engine

Trade Circulars and practical treatise on Steam Engineering free by mail.

CONTRACTS PROMPTLY EXECUTED.

These engines are carefully constructed for heavy and continuous duty at medium or high rotative speeds. Highest attainable economy in consumption of steam, and superior regulation guaranteed.

Address, BUCKEYE ENGINE CO., Salem, Ohio; or GEO. A. BARNARD, Eastern Sales Agent, Astor House, N. Y. D. L. DAVIS, Sales Agent, 23 S. Canal Street, Chicago, Ill.

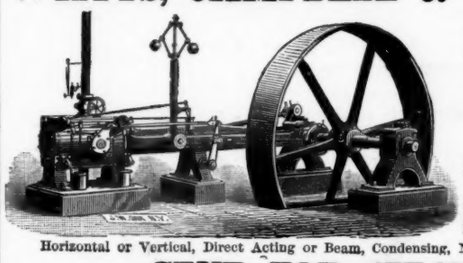
WATTS, CAMPBELL & CO., NEWARK, N. J.

MANUFACTURERS OF

Improved Corliss STEAM ENGINES

IN FULL VARIETY.

Sizes varying from 30 to 2000 H P.



Preferred above all others by the United States and Brush Electric Lighting Co.'s for regularity of speed and economy.

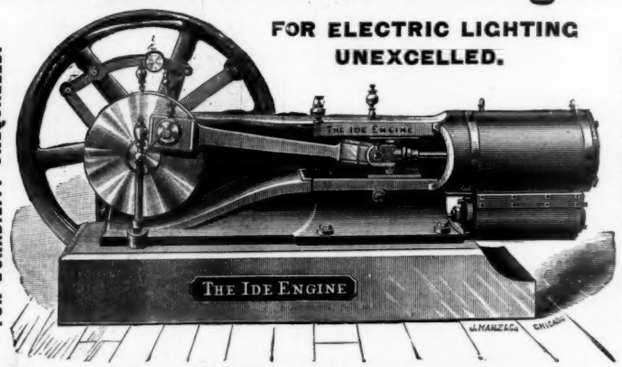
Horizontal or Vertical, Direct Acting or Beam, Condensing, Non-Condensing or Compound

SEND FOR CIRCULAR.

The IDE Automatic Engine.

FOR ELECTRIC LIGHTING UNEXCELLED.

FOR DURABILITY UNEQUALLED.



HIGHEST ECONOMY GUARANTEED.

A. L. IDE, SPRINGFIELD, ILLINOIS, U. S. A.

I. W. COLBURN & Co. MFG. OF Dynamo-Electric Machines Fitchburg, Mass.

VICTOR BISHOP & CO.,

IMPORTERS OF DIAMONDS,

DEUM COLE REGEM SERVA

PLATINUM

For all Manufacturing, Chemical, Electrical, Dental, and Laboratory purposes.

Victor Bishop & Co.,

ESTABLISHED 1837. No. 33 MAIDEN LANE, NEW YORK.

A. C. NORTHROP,

Waterbury, Conn.

Iron and Brass Machine Screws

ZINC IN SHEETS AND PLATE FOR ELECTRICAL PURPOSES.

Parts for Telegraph and Telephone Instruments,

MANUFACTURED FROM

Iron, Brass, Steel, or Zinc.

Opportunity to Estimate on patented articles from Sheet Metal, Rod or Brass Castings, respectfully solicited.

H. M. RAYNOR,

No. 25 Bond Street, New York.

ESTABLISHED 1859.

PLATINUM IN All Forms FOR ALL PURPOSES,

Wholesale and Retail

ESTABLISHED 1864.

WILLIAM A. HARRIS

MANUFACTURER OF

HARRIS-CORLISS STEAM ENGINES

With Harris' Patented Improvements

ALSO

Light and Heavy Iron Castings

PROVIDENCE, R. I.

Send for copy "Engineers' and Steam Users' Manual," by John W. Hill, M. E. Price, $1.25.

"OTTO" GAS ENGINE

OVER 10,000 IN USE.

Started Instantly by a Match. When Stopped all Expense Ceases.

Works without boiler, steam, coal, ashes or attendance. Successfully adapted instead of steam power in all industries and offers special advantages for running electrical machinery for Telegraph and Telephone as well as Lighting purposes.

Built in Sizes of 1, 2, 4, 7, 10, 15 & 25 Ind. H. P.

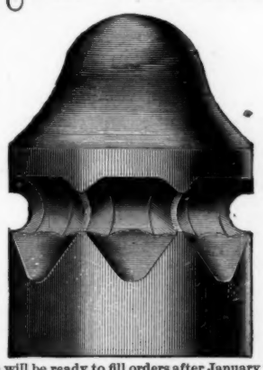
SCHLEICHER, SCHUMM & CO.

N. E. cor. 33d & Walnut, Phila.

Branch Office: 214 Randolph Street, Chicago.

THE FISKE & MOTT

High Resistance Insulator



We will be ready to fill orders after January 15th in order of receipt—in glass or of our patent composition.

For long lines, or wherever HIGH INSULATION is required, they are unequaled.

For prices, catalogues, etc., address,

THE CHICAGO INSULATING CO.,

122 La Salle St., Chicago, Ill.

MEMBERSHIPS.

At a meeting of the Directors of the

Electric, Manufacturing & Miscellaneous STOCK EXCHANGE,

it was resolved to close the subscription books for the first limited allotment of seats at $250, on or before Nov. 17th, prior to opening of the Exchange.

Application blanks may be had of and subscriptions made through and payable to the order of

The Third National Bank, No. 20 Nassau Street.
The St. Nicholas Bank, of N. Y., No. 7 Wall St.
The Chatham National Bank, No. 196 Broadway, or
Messrs. Hagen & Billings, bankers, No. 1 Wall St.

All applications must be accompanied by check and name and address of applicant. (The right to reject reserved.) Subscriptions can also be made to, and information obtained of, the Secretary, Duncan Building, No. 11 Pine Street.

TO INVESTORS.

The KEITH ELECTRIC COMPANY having secured and paid for valuable patents covering a complete system of Electric Lighting, and having demonstrated the economy and reliability of their light, are now prepared to push its introduction with the utmost energy. For this purpose a limited amount of the stock is offered for sale at $20 per share. For full particulars address,

* AUSTIN GALLAGHER,
DREXEL BUILDING,
Cor. Wall and Broad Sts., N. Y.

* Refers to Proprietors of the ELECTRICAL REVIEW.

BOULTON CARBONS.

These carbons are made of the

BEST MATERIALS,

and with the latest improved machinery, of **any required degree of hardness,** and can be used in all makes of Electric Lamps.

The regular sizes, 12 inches long, run from ¼ inch to 1 inch in diameter, varying by sixteenths.

Special Lengths and Sizes to Order.

A large and complete stock always on hand.

The want of a high order of battery plate has long been felt. Those wishing such would do well to use the

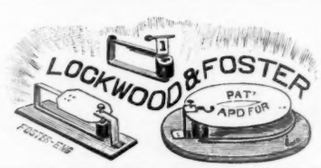
BOULTON PLATES.

Special attention is given to the manufacture of all sizes to order.

Price-Lists and full information furnished on application.

BOULTON CARBON WORKS,

PAYNE AVENUE,
CLEVELAND, O.



ELECTRIC COMPANY.

Telegraph Sounder and Key.

Not prepaid, $1.50. Prepaid, $2.00.

NEW ELECTRIC CALL, 75c.: NEW ANNUNCIATOR DROP, 75c.; NEW SOUNDER, $1.00; NEW SELF-CLOSING KEY, 75c.; PUSH BUTTONS, 20c. prepaid; 6 DROP ANNUNCIATOR, COMPLETE, $6.

Batteries, Wire, etc., for the above-named instruments. **Liberal Discount** to the trade.

The undersigned have thoroughly tested the "Lockwood & Foster Telegraph Sounder and Key," and Electric Bell, and find them both reliable, practical, working instruments. We therefore endorse them as the best and cheapest in the market.

Signed, THE FREEMAN ELECTRICAL MF'G CO.,
S. D. MOTT, 181 William Street, N. Y.
Electrical Draughtsman and Expert.
59 Astor House, N. Y.

We guarantee our Telegraph Sounder and Electric Call to work further with same battery power than any other sounder or Call in the world. Send for circular and remit for sample with your order.

AGENTS WANTED.

Lockwood & Foster Electric Company,
21 PARK ROW, N. Y.

American Electrical Works

MANUFACTURERS OF

Patent Finished Insulated

Electric Wires,

TELEPHONE AND ELECTRIC CORDAGE,

ELECTRIC LIGHT WIRE

MAGNET WIRE,

PATENT RUBBER COVERED WIRE, OFFICE AND ANNUNCIATOR WIRE, LEAD-ENCASED WIRE ANTI-INDUCTION AERIAL AND UNDERGROUND CABLES ETC., ETC.

OFFICE AND FACTORY:

No. 67 STEWART STREET,
PROVIDENCE, R. I.

EUGENE F. PHILLIPS, President.
W. H. SAWYER, Secretary and Electrician.

PARTRICK & CARTER,

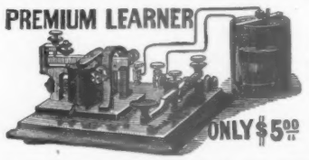
Philadelphia, Pa.,

MANUFACTURERS OF

Telephone, Telegraph

And Electrical Instruments and Supplies.

Among our SPECIALTIES are the CELEBRATED



Not the Cheapest, but GUARANTEED THE BEST.

COMPLETE OUTFIT ONLY $5.00.

The Fitch Chlorine Battery, patented Sept 16, 1879, acknowledged the **Best** Battery in use for Telephones, Annunciators, Call Bells, etc. Price, $1.50 per cell. Liberal discount to the trade.

The Acme Steel Lever Key, best and most perfect Key ever placed before the telegraphic profession; endorsed by hundreds of the most expert telegraphers in the country. Price by mail, $3.00.

The **Original Giant Sounder,** price $4.00 by mail. Send for our catalogues and price lists. Correspondence solicited.

PARTRICK & CARTER,

Telephone, Telegraph & Electrical Instruments and Supplies of every description,

114 SOUTH 2d ST., PHILADELPHIA, PA.

UNION ELECTRIC MN'F'G CO.,

Factory, 7 & 9 Bond St., } NEW
Office, 145 Broadway, } YORK,

Manufactures all kinds of

Telegraph, Gold and Stock,

DISTRICT & DOMESTIC APPARATUS.

Students and Inspectors Portable Wheatstone Bridge and Galvanometer Combined.

DEALERS IN

ELECTRICAL SUPPLIES

OF EVERY DESCRIPTION,

BEST GOODS. LOWEST PRICES.

Lines Equipped with Quadruplex and Duplex Systems (patents protected).

Correspondence Invited.

THE

Law Battery.

The BEST Open Circuit Battery in the World and the CHEAPEST.

Combines all the advantages of the best of the others, without any of their disadvantages. Thousands sold monthly. Send for circular. Manufactured and sold by the

LAW TELEGRAPH CO.,
140 Fulton St., New York.

LECLANCHE

...rism Battery, Complete. Size of Jar, 6x4½ inches.

THE GREAT

TELEPHONE BATTERY.

The Standard Open Circuit Battery of the World.

OVER 500,000 CELLS NOW IN USE IN THE UNITED STATES AND 1,000,000 IN EUROPE.

ADOPTED BY ALL THE

Telephone Companies.

THE SIMPLEST, CLEANEST, MOST DURABLE, MOST ECONOMICAL.

Beware of Infringements and Cheap Imitations.

LECLANCHÉ BATTERY CO.

149 W. 18th St., N. Y., or
L. G. TILLOTSON & CO., 5 & 7 Dey St., N. Y.

MANUFACTURER OF SUPERIOR

CARBON POINTS AND PLATES.

∴ ∴

BUFFALO ELECTRIC WORKS

1590 to 1620
NIAGARA STREET,
∴ BUFFALO, N. Y.

THE BERGMANN & HAID BATTERY.

The Greatest Open Circuit Battery in the World.

Superior to the Leclanche and all others, for Telephone, Annunciator, Burglar Alarm, and all open circuit work.

Price (complete) **$1.25.**

Liberal discount to dealers.

Send for descriptive Circular and Price List.

BERGMANN & CO.
Electrical Works,
292, 294, 296 & 298
AVENUE B,
NEW YORK, N. Y.

PAT'D {Oct. 16, 1883. Nov. 20, 1883.

ALFRED F. MOORE,

MANUFACTURER OF

Insulated Wire,

—FOR—

Telephone, Telegraph and Electric Light,

OFFICE, LINE,

—AND—

ANNUNCIATOR WIRE,

Magnet Wire and Flexible Cordage,

200 & 202 N. THIRD ST.,

PHILADELPHIA, PA.

PHOSPHOR-BRONZE

TELEPHONE WIRE,

Insulated and Bare.

"Phosphor-Bronze."

Combines High Electrical Conductivity and Resistance to Corrosion with Lightness and Tenacity.

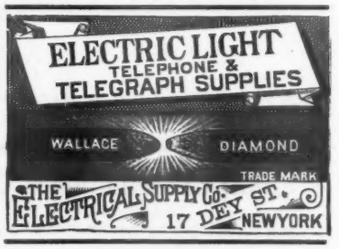
Standard Sizes, 16, 17, and 18, Stubs' Gauge.

ADDRESS;

The Phosphor-Bronze Smelting Co. (limited,)
512 ARCH ST., PHILADELPHIA, PA.

Owners - of - the - United - States - Phosphor-Bronze - Patents.

Sole Manufacturers of Phosphor-Bronze in the United States.



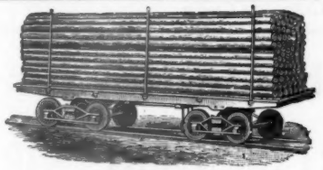
SPIRAL TELEPHONE WIRE.

For Long & Short Distance Telephoning

Patents allowed April 24, July 25, 1883.

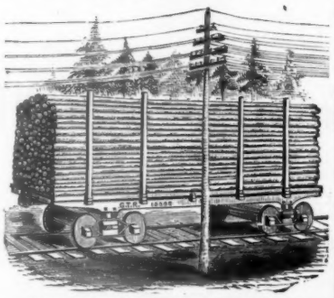
American Spiral
Telephone Wire Company,
43 Milk Street,
BOSTON, MASS.

THE
TRENTON IRON CO.
MANUFACTURERS OF
GALVANIZED IRON WIRE
OF VARIOUS GRADES FOR
Telegraph and Telephone Lines.
WORKS AND OFFICE AT
TRENTON, NEW JERSEY
NEW YORK OFFICE:
Cooper, Hewitt & Co., 17 Burling Slip.
PHILADELPHIA OFFICE:
21 NORTH FOURTH STREET.



CEDAR
TELEGRAPH POLES
From 25 to 60 Feet in Length.
Seasoned ready for immediate delivery. The Largest and Best Selected Stock in Michigan. We quote prices delivered at any Railroad Station in the United States.
BROWNLEE & CO.
DETROIT, MICH.
[Please mention this paper.]

HANDSOME **POLES** & DURABLE.

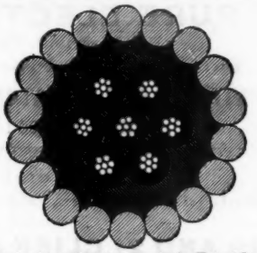


CANADIAN CEDAR POLES, the best in use; live 25 to 35 years; good appearance. Prompt delivery at Buffalo, Black Rock or Suspension Bridge, N.Y. Cheap for spot Cash. Address
HARVEY, STAFFORD & CO.,
ACTON, Ont., Canada.

WESTERN
ELECTRIC COMPANY.
Chicago, Boston, New York,
MANUFACTURERS OF
Telegraph Instruments & Supplies
Insulated Copper Wires, Electric Bells and Annunciators, Burglar Alarms, the Electro-Mercurial Fire Alarm, Electro-Medical Apparatus, Electric Gas Lighting Apparatus, Edison's Electric Pen and Duplicating Press, the Gamewell Fire Alarm Telegraph Apparatus, Telephone Exchange Apparatus, Underground Cables.
ANSON STAGER, President. ENOS M. BARTON, Vice-President.
CATALOGUES
Sent by Mail on Receipt of Price in Stamps or Currency.

	Pages.	Price.
I—Complete set of Catalogues	256	25c.
II—Telegraph Instruments and Supplies	64	6c.
IV—Insulated Wire (included in II.)		
V—Electric Bells, Annunciators, Electro-Mercurial Fire Alarm	32	3c.
VI—Electro-Medical apparatus	32	
VII—Manual of Telegraphy and Catalogue of Private Line Instruments	32	free.
VIII—Condensed Price List	20	free.
X—Electric Bells, etc., descriptive	12	3c.
XI—Magnets for Mills	20	3c.
Sir William Thomson's Nautical Instruments	24	5c.

The Bishop Gutta-Percha WORKS.
SAMUEL BOARDMAN, Agent.)



Original and only Manufacturers in the United States.
GUTTA-PERCHA INSULATED
Submarine Telegraph Cables,
50 Regular Sizes. One to Ten Conductors.
Subterranean Telegraph Cables,
Hempen-Armored Covered.
Aerial Telegraph Cables,
Lead or Hempen Covered.
ANTI-INDUCTION
Telephone (Lead-Covered) Cables,
As used by the Metropolitan Telephone & Telegraph Co.
Torpedo Cables,
Recommended by the European and South American Governments.
Lead-Covered Cables,
For Canal and Streamlet Crossings.
Gutta-Percha Office Wire, Leading and Connecting Wire,
For Subaqueous Mining and all other Electrical purposes.
Mark's Compound Insulated Wire,
For Office, Outdoor, Underground, and Battery Use.
G. P. Office Wire, Cotton-Covered.
ALSO HAVE ALWAYS ON HAND:
Wires of every variety of Insulation,
Magnet Wire, Telephone Flexible Cords, Flexible Elevator Cables, Electric Cordage, Burglar-Alarm and Annunciator Wire, Electric Light Wire, Cordage and Cables, Lead-Covered Wire, and every description of pure Gutta-Percha goods, Gutta-Percha Sheet, for Cable Splices; G. P. Chemical Vessels for Acids, etc.
Agents for Reception of Orders and Sale of Goods:
L. G. TILLOTSON & CO., 5 & 7 Dey St., New York.
WILLIAM HEATON, 503 Chestnut St., Phila.
Thirty-three years' experience has taught us that neither the electrical nor mechanical qualities of either Gutta-Percha or Copper deteriorate by long working or submersion, consequently the best form of a Submarine Telegraph cable will be that in which these conditions were fulfilled.—*Extract from Report on Cables, by Willoughby Smith.*
MANUFACTURED BY
The Bishop Gutta-Percha Works.
Address all communications to
W. W. MARKS, Superintendent,
420, 422, 424 & 426 East 25th St., N. Y.
OFFICE AT THE WORKS.

Rhode Island Telephone and Electric Co.
PROVIDENCE, R. I.,
MANUFACTURERS OF THE
Providence Telephone Switch-Boards,
BRECKENRIDGE JACKS,
Wright Cable Clips,
Howard Safety Appliance,
For protection to telephone subscribers against Lightning or Electric Light currents.
Dealers in Electric Appliances of every description.
Manufacturers and constructors of Lightning Rods upon scientific principles.
Licensees of The Time Telegraph Co. of New York for the New England States. Energetic men with capital wanted to form local plants in territory not yet disposed of.
Correspondence solicited from inventors, or parties having electrical novelties, with a view either to purchase or introduction as agents.
HENRY HOWARD, President.
C. T. HOWARD, Treasurer.
J. W. DUXBURY, Sec'y and Gen. Manager.
F. H. GARDINER, Assistant Manager.

S. W. FRENCH, President. W. C. DEWEY, Treasurer. FRANK F. BULLARD, Gen'l Manager.
PALMER WIRE COMPANY
PALMER, MASSACHUSETTS.

GALVANIZED
Telegraph & Telephone Wire
In Long Lengths, by our Continuous Process, and Pronounced by all Users as Unsurpassed in
QUALITY OF MATERIAL, FINISH AND CONDUCTIVITY.
Testimonials of same furnished if required. Line Men have less trouble with our Wire than with any other make. Put up in Half Mile Lengths.
Approximate diameter of Wire drawn by PALMER WIRE GAUGE, in thousandths parts of an inch.

No. 4—.225	No. 7—.177	No. 10—.135	No. 13—.092	No. 16—.063
No. 5—.207	No. 8—.162	No. 11—.120	No. 14—.080	No. 17—.054
No. 6—.192	No. 9—.148	No. 12—.105	No. 15—.072	No. 18—.047

Estimates on complete equipment of Private Lines furnished on application. Correspondence solicited.
New York Office, 20 Cliff Street.

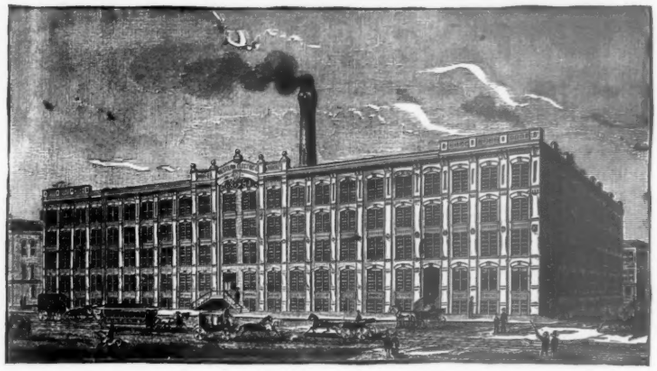
JOHN H. MUEGGE,
IMPORTER OF
PLATINUM.
Manufacturer of all kinds of Chemical Apparatus Crucibles, Vessels, &c., Wire for Electrical Purposes Plate and Wire for Dentists. Scraps Purchased.
No. 91 Liberty St., New York.

BUTLER'S SAFES
FIRE & BURGLAR PROOF.
291 BROADWAY,
NEW YORK.

THE
United States Electric Lighting Co.
SOLE MANUFACTURERS OF
WESTON DYNAMO-ELECTRIC MACHINES
For both Arc and Incandescent Lighting.
WESTON ARC LAMPS, AUTOMATIC REGULATORS, FIXTURES, CARBONS, &c.
MAXIM INCANDESCENT LAMP.
And all Apparatus necessary for the most COMPLETE, EFFICIENT and RELIABLE SYSTEMS of Electric Arc and Incandescent Lighting.
OFFICE: 59 & 61 LIBERTY ST., NEW YORK.
George W. Hebard, *Pres.* Leonard E. Curtis, *Sec.* Ph. Ferd. Kobbé, *Treas.*
TRUSTEES:
Marcellus Hartley, Edward Weston, Henry B. Hyde, Anson Phelps Stokes,
Walter T. Hatch, John A. Stewart, Charles R. Flint, Henry Day,
Robert B. Minturn, Louis Fitzgerald, George W. Hebard, Leonard E. Curtis,
Thomas H. Hubbard.
☞ SEND FOR CATALOGUE. ☜
Perfect Automatic Regulation in both Systems.

Western Electric Company,

CHICAGO--BOSTON--NEW YORK,



Chicago Factory, 227 to 251 South Clinton St.

Telegraph and Telephone Apparatus

AND SUPPLIES.

The Best of Everything at Bottom Prices.

A. G. DAY

MANUFACTURER OF
KERITE INSULATED
TELEGRAPH & TELEPHONE

WIRE & CABLES,

OFFICE, 120 BROADWAY, N. Y.—FACTORY, SEYMOUR, CONN.

Anti-Induction Kerite Telephone Cables.

Some of them Two Miles in Length, are in use in several cities, and are found to WORK PERFECTLY for that distance. EMINENT ELECTRICIANS and PRACTICAL TELEGRAPHISTS commend and recognize the Kerite Insulation as superior to all others. At the Centennial Exhibition at Philadelphia, Sir William Thomson, the eminent Electrician and Scientist, awarded to the KERITE INSULATED WIRE AND CABLES

A DIPLOMA

FOR "EXCELLENCE OF THE INSULATION AND DURABILITY OF THE INSULATOR."

GENERAL AGENT:

CLARK B. HOTCHKISS,—120 BROADWAY, NEW YORK.

THE BAXTER ELECTRIC LIGHT CO.

Is prepared to negotiate for New Plants, Complete.

THE BAXTER
IMPROVEMENT IN

ELECTRIC LAMPS

IS THE

Greatest Invention in Arc Lighting yet made.

Efficient, Reliable and More Economical than any other Lamp in the World, and can be applied to any System. SAVES FROM ONE-HALF TO THREE-QUARTERS THE COST OF CARBONS.

For terms for territory and cost of Baxter attachment, address:

THE BAXTER ELECTRIC LIGHT COMPANY,
MILLS BUILDING,
NEW YORK.

The Keystone Electric Co. of Philadelphia, Agents for Pennsylvania.

THE ANSONIA BRASS & COPPER CO.,

MANUFACTURERS OF

PURE ELECTRIC COPPER WIRE,

For Magnets, Telephones, Electric Light, &c.,
Patented Fire-Proof Electric Light Line Wire,
PATENTED FIRE & WEATHER PROOF ELECTRIC LIGHT LINE WIRE,
Patented Paragon Line Wire—Fire Proof, Water Proof,
"ACME" BRONZE TELEGRAPH AND TELEPHONE WIRE,
Wrought Metal Gongs for Annunciators,
Telephones, &c., Zinc Rods, Battery Copper, &c.,
WAREROOMS:
19 AND 21 CLIFF STREET, NEW YORKCITY.
Factories, Ansonia, Conn.

Holmes, Booth and Haydens,

MANUFACTURERS OF

FIREPROOF ELECTRIC LIGHT WIRE,

From Pure Lake Superior Copper.—Conductivity Guaranteed.

PATENT

"K. K." Insulated Copper and Iron Wire,

FOR TELEPHONE AND TELEGRAPH USE.

General Agents for the Pittsburgh Carbon Co.

49 CHAMBERS STREET, NEW YORK;
18 FEDERAL STREET, BOSTON.

WORKS AT WATERBURY, CONN.

ARMINGTON & SIMS ENGINE

AWARDED THE **GOLD MEDAL**

at the Cincinnati Exposition, and a special Diploma "for the Best Quick Acting Engine, for its Intrinsic Merit, Many Points of Excellence, and Thorough Workmanship." Also the first Medal at the Southern Exposition at Louisville, Ky., "for the Best Quick Acting Steam Engine for Electric Light;" also the Highest Award of the Industrial Exhibition Association, Toronto, Canada, for High Speed Engines Built and Exhibited by the John Doty Steam Engine Company.

ARMINGTON & SIMS ENGINE CO.

PROVIDENCE, R. I.

SELLING AGENTS:

JARVIS ENGINEERING CO., 61 Oliver St., Boston. MARKLE & HALL, Detroit, Mich.
POND ENGINEERING CO., St. Louis, Mo. J. F. RANDALL, Warren, Ohio.
H. B. SMITH MACHINE CO., Phila., Pa. T. W. ANDERSON, Houston, Texas.

M. F. MOORE, Gen. Agent,
No. 15 Cortlandt Street, New York.

THE BRUSH ELECTRIC CO., CLEVELAND, OHIO.

The Sole Manufacturers under all the Patents of Chas. F. Brush for Electric Lighting, Storage Batteries, &c.

We furnish the only complete and PERFCT SYSTEM of electric lighting.
The best DYNAMO Machines. The ONLY PRACTICAL Storage Batteries.
The best arc lamps. The purest and best Carbons, &c.

Our prices are the lowest, our factory the largest and our business the most extensive in the world to-day.

SEE THE LIST. **ELECTRIC LIGHT MACHINES. Standard Sizes.**

No. of Mch.	2	2	3	3	4	4	5	5	6	6	7	7	8
No. of lights 2,000 c.p.	1		2		4		10		20		30		65 00
No. of lights 1,200 c.p.	2		3		6		15		30		45		
H.P. required.	1½	1½	3	3	4	4	8	8	14	14	22	22	45
Price,	$300.00	$300.00	$415.00	$415.00	$565.00	$565.00	$900.00	$900.00	$1,500.00	$1,500.00	$2,000.00	$2,000.00	$3,600.

Single Lamps $50.00. Double Lamps $80.00. Send for details.

The Brush Electric Company, No. 104 Euclid Ave., Cleveland, Ohio.

INCANDESCENT LIGHTS

SWAN INCANDESCENT ELECTRIC LIGHT CO.

OWNERS OF THE

SWAN PATENTS FOR THE UNITED STATES,

ARE PREPARED TO GRANT LICENSES TO COMPANIES TO SELL AND USE THE SWAN INCANDESCENT LAMP, INCLUDING OUR PATENTED HOLDERS, SWITCHES, CUT-OFFS, ETC. WE GUARANTEE OUR LAMP AND TO DEFEND THE VALIDITY OF OUR PATENTS. FOR TERMS OR INFORMATION, APPLY TO

THE SWAN INCANDESCENT ELECTRIC LIGHT CO.,
853 Broadway, Cor. 14th Street, New York